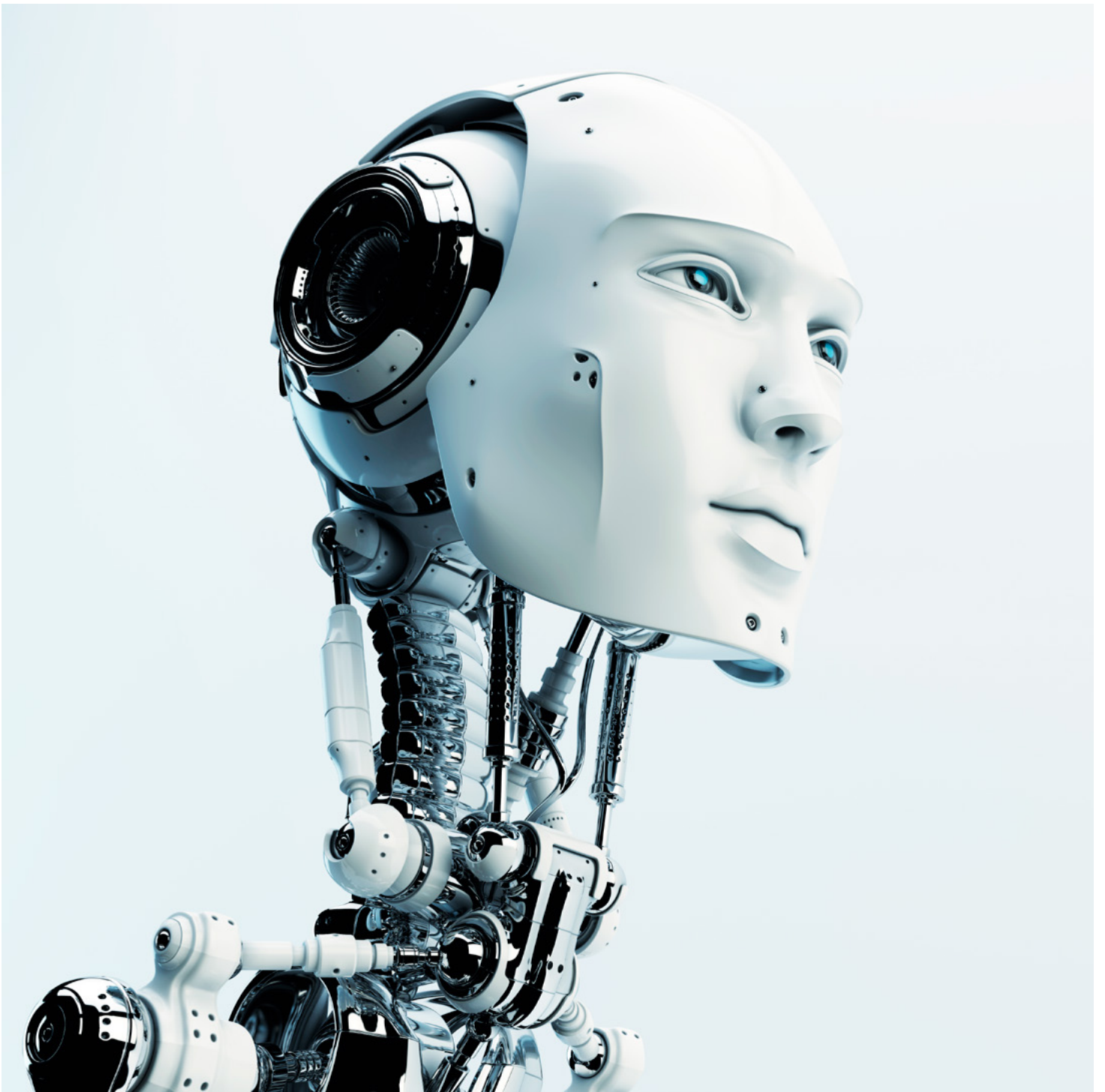


Intelligent Automation

A UBS Group Innovation **White Paper**



Foreword

In January 2016 we published a paper for the meeting of the World Economic Forum about the coming fourth industrial revolution.¹

In it we suggested that if the first three industrial revolutions took us from steam engines to mass production to our modern IT and communications, the new age would bring us a world of extreme automation and connectivity. As with the first three such revolutions, this would be the catalyst of profound change.

Since then we have been examining the coming fourth industrial revolution in more detail from a number of different angles.

In mid-2016, we published a major white paper on the blockchain, a new technology – very much in the fourth industrial revolution mold – that we believe may, among other things, cause massive disruption and transformation to the global financial system.

To further explore prominent fintech themes, in the fall of 2016 we launched our Future of Finance Forum series with a Forum on Digital Identity.² At these events we bring together leaders and experts from around the world to look at aspects of how the fourth industrial revolution may play out in our economy and society in general, as well as in financial services more specifically.

We follow each Forum with a white paper. This one, on artificial intelligence and intelligent automation, addresses the technology that is likely to drive the most significant technological advances in financial services over the mid to long term. To deliver this white paper we have collaborated with the Swiss artificial intelligence lab 'IDSIA' (Istituto Dalle Molle di Studi sull'Intelligenza Artificiale), a non-profit oriented research institute that focuses on machine learning, operations research, data mining, and robotics. Our view is that thinking machines will make banks better at what they do and how they do it. What this means for banks, bankers and banking clients is what we explore here.

This paper is intended for a general audience. It is part of our ongoing efforts to provide information and insight on important topics for those who rely on our services, as well as to society at large.

We hope you will find it thought provoking reading.

Axel P. Lehmann
UBS Group Chief Operating Officer

1 'Extreme automation and connectivity: The global, regional, and investment implications of the Fourth Industrial Revolution'. UBS White Paper for the World Economic Forum Annual Meeting 2016, published January 2016.

2 'Digital Identity'. UBS Group Innovation White Paper, published December 2016.

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Introduction

What is intelligent automation and what does it mean for us? Exploring this and related questions on the role and application of artificial intelligence (AI) in financial services, this paper offers a number of perspectives on what we see unfolding today; How did we get here? What is currently relevant? And what might the future hold?

In our view, banks currently face a number of specific problems for which intelligent automation – and within this the capability of AI – may provide solutions. Far from becoming our new masters, our prediction is that thinking machines could become our most trusted assistants, enhancing our productivity through providing us deeper and more timely information, and perhaps even automating the business of generating insights and making considered decisions.

We believe that intelligent automation will, above all, enhance human capabilities and allow us to free people from routine work, empowering them to concentrate on more creative, value-added services. The overall benefits to the economy from such enhancements could be large, as could the benefits in terms of enjoyment of work and quality of life.

The current (re)emergence of AI, which is contributing to the broader intelligent automation trend, seems to be driven by several key factors. The availability of unprecedented amounts data (much of it unstructured), the exponential increase in computer processing power, the declining price and growing convenience of data storage solutions, and recent advances in machine learning algorithms, all provide a powerful toolset for making significant strides in intelligent automation.

We strongly believe that financial services organizations – like firms in other industries – need to harness the potential benefits on offer. Our world is becoming so inherently data-driven that only AI's more capable, dynamic tools will be able to harness this information and to put it to useful work.

There is much that can be done. For one, AI will likely help banks create better client experiences through ever more personalized, on-demand services. Although they offer personalized services today, AI can help bankers better understand clients and their needs, as well as aggregate and evaluate more real-time information relevant to their clients' specific situations. We think that AI will help banks better execute on their promises of service excellence. And in our view, AI will also allow banks to put better and more powerful financial and wealth management tools into their clients' hands.

AI can also help make banks safer, significantly improving the means for combatting cyberattacks. And it has the

potential to make banks smarter, too. By learning how markets behave, and providing improved market intelligence, more profound market insight and better assessments of risk, AI can help banks offer deeper, broader and altogether smarter investment advice.

Furthermore, AI offers the potential to reduce costs. Banks already spend a significant share of their development budgets on projects to automate routine processes. This is happening first in the 'back office', where we see intelligent software agents executing manual, easily-defined administrative processes. As machines become more 'intelligent', they will be able to undertake more complex tasks, like credit scoring or automated report writing. Although it may seem expensive now, by helping to usher in truly intelligent automation, AI can help banks achieve significant economies of scale.

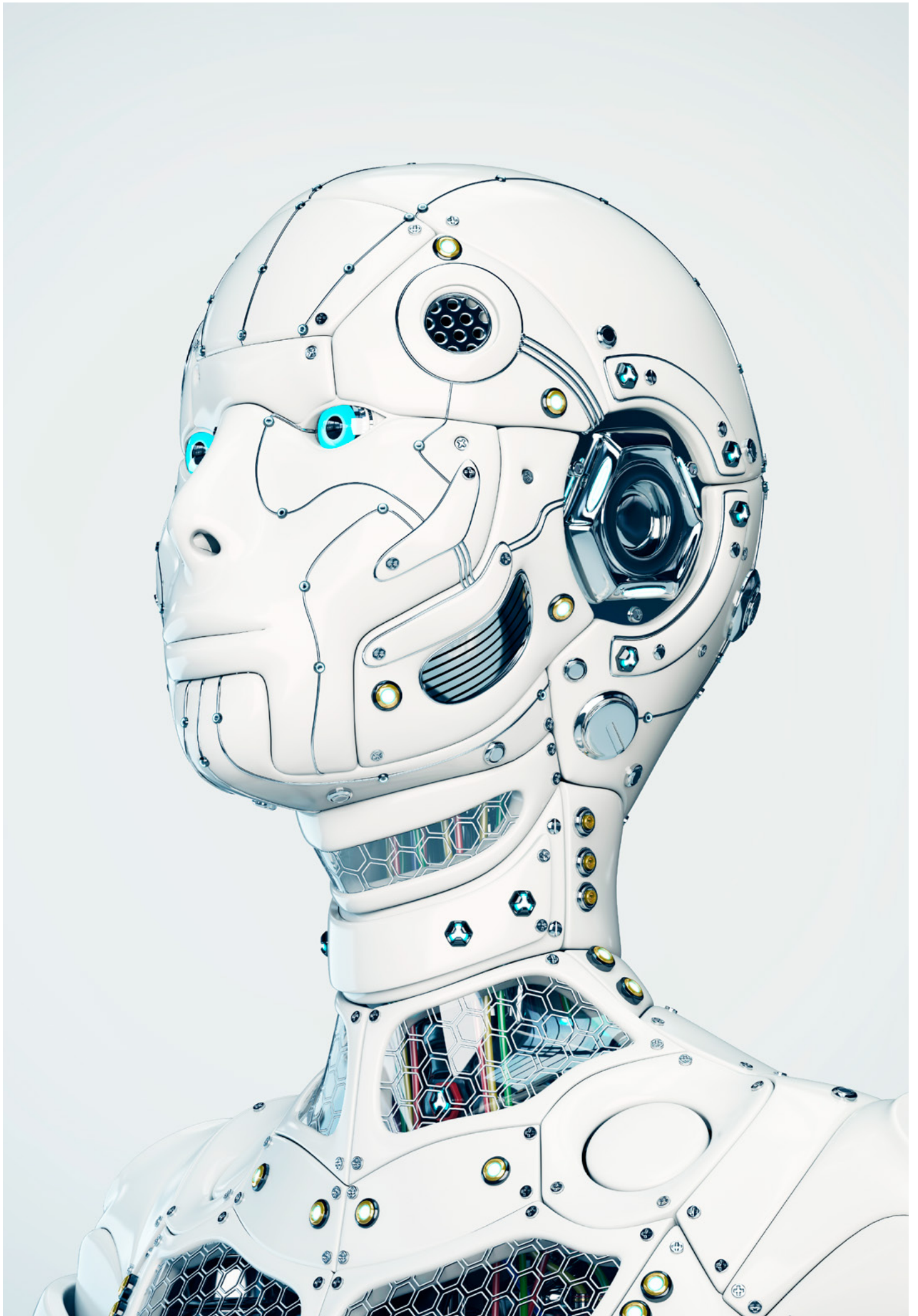
While we think AI will play a significant role in financial services, the path for intelligent automation will not be straightforward; all organizations can expect to face hurdles on the way.

To succeed, AI will have to be robust and compliant. Financial services organizations and regulators will need to work together to agree on prudent rules that protect consumers and society without stifling innovation. Issues of liability will also have to be addressed so that banks, their partners and other stakeholders have clarity on risks and responsibilities.

Banks should also not underestimate issues around the acceptance of AI by their workforces and clients. AI promises great benefits, but it also causes anxiety. To gain acceptance for AI banks need to clearly communicate its benefits, while being honest about the risks. We think one way to do so is through papers like this.

It is difficult if not impossible to say how the AI future will play out. The history of AI is full of predictions that turned out to be off the mark, and perhaps only in retrospect will we be able to clearly see the path we have taken.

No matter how long the journey takes, we believe it should be made, and are confident that it will be – and that the impact will be significant and ultimately beneficial.



Cogito, ergo sum machina: The history and promise of artificial intelligence

People have long dreamed of building machines that can think and act like humans. Today's advances in computer science and other fields look set to make this dream a reality. But what is artificial intelligence, and what can it do for us?

Fits and starts

The question of whether it is possible to build a machine that can think has intrigued human beings for millennia: myths of "artificers" creating walking and talking robots can be found in ancient China and classical Greece. It was only with the rise of digital computing after World War II, however, that scientists were ready to tackle the problem in earnest.

It looked easy at first. At a famous conference in Dartmouth in 1956, often cited as the beginning of AI as an academic discipline, the 10 participants felt six weeks would be enough to solve the bulk of its theoretical challenges.

It did not turn out that way. Instead the first 50 years of AI have been characterized by fits and starts. After impressive early successes, researchers repeatedly ran into walls. During two periods of its history – the so-called "AI winters" – difficulties were so great that interest in, and funding for, the discipline almost ceased.

This has now changed. Increased computing power, the availability of large amounts of digitized data, better techniques, and strong interest among consumers and companies for AI-based capabilities have led to significant advances. There is intense interest in the academic community as well, and companies like Google, IBM, Facebook and Microsoft have all announced that AI will shape their futures.

It looks like AI is now here to stay, and the dream of an intelligent machine no longer a question of if, but when. Yet what do we really mean when we talk about "artificially" created intelligence?

Cogitating about cogitating

To be fair to those participants in the Dartmouth conference, many of whom went on to make important contributions to the field, one thing that makes it very difficult to teach machines to be intelligent is the difficulty in pinning down exactly what intelligence is.

In 1950, Alan Turing, one of the founding fathers of AI, suggested that if our interactions with a machine are indistinguishable from those with a human, then the machine can be said to be 'intelligent'. Despite subsequent debate about the value of the now famous "Turing Test", we think this makes for a reasonable benchmark. And while it seems an eminently reachable goal today, the road to this point has been long and difficult.

Early AI techniques relied on reason and logic – various sets of rules and symbolic manipulations that helped machines arrive at solutions. Results were often impressive: programs that could prove mathematical theorems, write music, or play chess. But the scope was always limited. Deep Blue, which in 1997 became the first machine to beat the world's best chess player, could not play tic-tac-toe or tie a shoelace. Can it be said to be intelligent?

Thinking, at least in the human way, involves much more than just solving problems through reason. One of the biggest surprises for early AI researchers (known as Moravec's paradox) was that, while it was relatively easy to school computers in advanced reasoning, it turned out to be very hard to teach them to do seemingly simple things like recognizing a piece of candy, or walking across a room to pick it up.

In the quest to create machines that truly think, AI has had to expand to cover all the capabilities that feed into the kind of broad intelligence that allows us – human beings – to interact successfully with our environment.

Today, researchers are working on ways to teach machines to perceive their environment by seeing and hearing; to learn about their environment by listening to people talk or reading books; to understand their environment and context through inference and experience; to make plans by understanding how their actions might shape their environment; and to act, either by manipulating their environment or communicating – and cooperating – with others in it.

There are many different ways to teach machines to do these kinds of things. Right now machine learning, which involves educating computers by exposing them to lots of data, is particularly popular – show a computer enough pictures of cats, and at some point it will recognize most cats. But there are other approaches as well: teaching machines to make decisions based on probability, utility or causality, for instance.

The point is that ‘artificial’ intelligence is as multi-faceted and fascinating as the human kind. For the moment, AI activity remains focused on specific domains. The question remains if we can one day bring all these domains together to achieve “artificial general intelligence” or “strong AI” – that is, build machines able to achieve goals in a wide range of contexts, and deal with change and uncertainty as easily as we humans do.

“Artificial Intelligence has become a crucial enabler for delivering today's customer experience in order for large financial institutions to stay relevant. Such an AI must intelligently connect to the digital self of the customer and understand real intent of customers.”

Sindhu Joseph, CogniCor Technologies
Future of Finance Forum participant

Indications are that this indeed will be possible, though not in the immediate future. No matter how it plays out, thinking machines will certainly change our world in profound ways. And in fact, they already are.

Talk to me

AI is all around us. Some of it is obvious, like the digital assistants in our phones. But today most AI operates in the background. When people and objects in our smartphone camera rolls are automatically recognized, or when we read machine-written news pieces, we are already enjoying the services of a thinking machine.

Over the past few years we have seen impressive progress in three main areas of high relevance to AI. Major advances in computer vision mean that machines are learning not just to see, but to recognize what they see: objects, faces, the emotions traced in those faces. Similarly, advances in voice recognition mean that machines are learning to listen: to recognize who is speaking to them and read the

nuances in the way words are said. Third, advances in natural language capabilities mean that machines are learning, rapidly, to understand the content of what they read or what is said to them – and learning how to use human languages and dialects to respond.

These capabilities will improve further, and over the next five to 10 years machine perception will likely become “superhuman.” That doesn’t necessarily mean machines will be able to see, listen and speak better than we do, but they will be able to handle far more conversations, deal with more problems, and remember more facts than we can.

This will among other things open the door to “Conversational AI” (you need no longer search the Internet, just ask the machine) and “human aware” AI that individualizes tone, language and behavior based on who it is dealing with.

Skynet, or heaven sent?

For many, this will seem miraculous. Others will find it frightening – worrying that thinking machines will put them out of a job, or take over the world.

Such fears are not completely unreasonable. According to a recent paper out of Oxford, half of jobs in the United States and European Union may indeed be susceptible to “computerization”, of which AI will play a significant role.³

Established philosophers and scientists like Nick Bostrom and Stephen Hawking, and noted technologists like Bill Gates and Elon Musk, have warned of a potential AI Armageddon – of building machines that will enslave us.⁴

While it is certainly true that previous industrial revolutions have seen winners and losers, on balance we believe such dire predictions are likely overblown.

Just because AI-powered machines will be able to do more of our work for us doesn’t mean there will be no more work to do. As has happened in past industrial revolutions, it will simply mean that the kind of work we do changes. If machines take over the mental drudgery for us, freeing us to concentrate on more high-level, creative tasks, people may even find their work to be much more interesting and fulfilling than before.

And far from becoming our new masters, thinking machines may become our most trusted assistants, enhancing our capabilities through providing us deeper and more timely information and insight. The overall benefits to the economy from such enhancements could potentially be quite large, as could the benefits in terms of enjoyment of work and quality of life.

3 C. Frey and M. Osborne (2013) ‘The Future of Employment: How Susceptible are jobs to computerisation?’ See: http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

4 N. Bostrom (2014) ‘Superintelligence: Paths, Dangers, Strategies’.

The pocket accountant: AI and personal financial managers

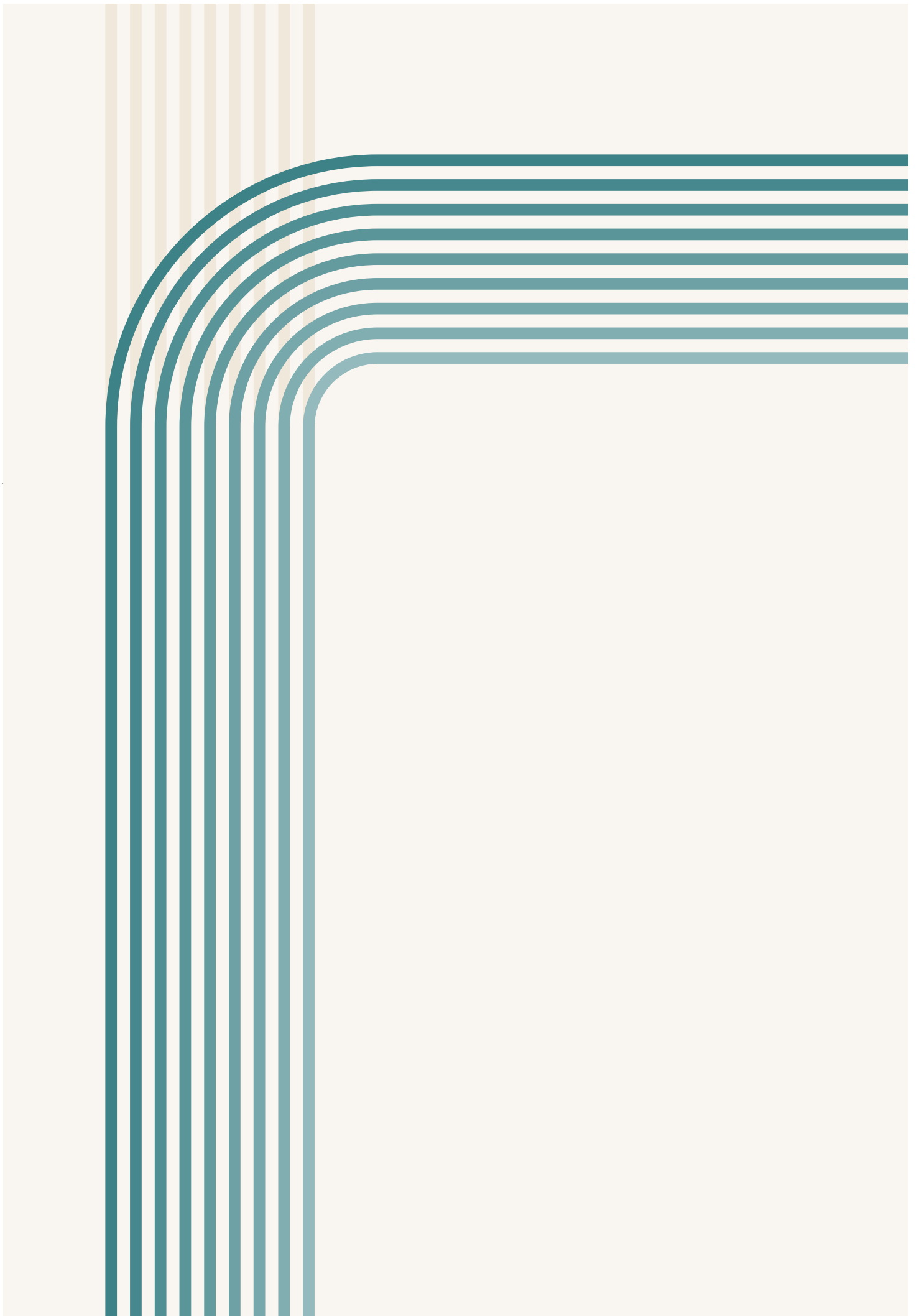
Wouldn't it be nice to have your own financial secretary who would pay all your bills on time, keep track of your spending, help you figure out what your cash flow will look like in the future, and perhaps even uncover some extra cash at the end of the month?

That's the promise of AI-enabled personal financial management (PFM) software. PFMs are not new. There are many on the market and some have been around for quite a while. But most of these can only look backwards: they can analyze your account information and reveal your past spending habits.

AI-enabled PFMs, such as we are now beginning to see in the market, can look into the future. For instance they can analyze all your transactions, figure out which ones are repeating, and use that information to extrapolate what your future bills will be – and if you want, pay them for you.

This can be more than just a convenience. Depending on how much access you give the system to your information, an AI-enabled PFM can alert you to pending cash flow problems or, better, show you where you might save some money. Similarly it can spot anomalies – a phone bill that is suddenly twice as high as usual, or an unexpected utility bill. This can alert you to foul play or act as a (gentle or not so gentle) reminder that you might be overspending.

Intelligent assistants can theoretically do more. Because they are able to learn, they can over time make better predictions about your spending habits. They can also follow your instructions, so that you can give them increasingly complex things to do. AI can also be used to make PFMs far more interactive. A recent startup, for example, has designed a voice-recognition add-on for mobile banking apps. Next time you want to know how much you spent in restaurants last month, you can just ask your phone.



Field of dreams: AI and financial services

The field of artificial intelligence has reached an inflection point, and holds the promise of great advances in many industries and areas of our lives. Financial services is no exception.

Data bank

Ask bank strategists today what the most significant development in financial services over the next 20 years will likely be, and they will regularly tell you the application of AI.

We believe thinking machines are likely to perform many tasks that are core to 'traditional' banking, and do so in ways that are more accurate and more reliable than can be accomplished by humans. One main reason is the way AI-enabled systems are able to handle data: this is intelligent automation - using AI to make certain core banking processes machine-assisted or fully digitized.

Most routine processes in financial services today involve massive amounts of data, and banks are forced to efficiently make sense of this information while operating within a myriad of regulations and client requirements. If this were not challenging enough, data volumes are growing exponentially while the rules and regulations around data handling are prone to change. The data silos and data graveyards commonplace in large financial services organizations also constrains banks' ability to continually achieve a competitive return-on-equity. Add in the task of harnessing unstructured data (see below), and banks have a clear need for solutions provided by AI – assuming, of course, it can overcome the huge challenge of making sense of legacy data.

As is well known, revenue growth in financial services remains challenging while costs are rising, driven in part by regulation and increased complexity. Banks already spend a significant share of their development budgets on projects to automate routine processes. Although it may seem expensive now, by supporting intelligent automation, AI offers the promise of significant economies of scale.

Bank customers are also becoming more demanding and market infrastructure players are building data-centric business models that center on 'data as an asset'. In this age of Google, Apple, Facebook and Amazon, we have become used to personalized services being offered on the basis of data that consumers provide for free. While bank clients increasingly expect the same levels of innovation, transparency, advanced online interfaces and easy access to products and services, established banks sometimes struggle to meet these demands while making use of the personal and financial client data they own. This data is useful and valuable and AI may help banks create superior client experiences through ever more personalized interactions, and do so in an efficient, industrialized way.

Perhaps most acute, modern financial systems rely on massive amounts of volatile and dynamic data – more so than most industries – and as mentioned, volumes are growing exponentially across almost all data streams. In short, AI likely offers our best chance of being able to channel and interpret these flows.

Banks are also gaining access to increasing amounts of unstructured data – the 'free range' information contained in, for example, emails, news articles, or the records of telephone conversations. The challenge of gathering and making good use of this data is very different than with the more formally structured information of the type typically found in databases. Here too, AI likely offers the best hope of a solution, although we think fully utilizing unstructured data is some way off.

“The availability of data is unparalleled today: this creates challenges but also opportunities. The key question is how to leverage the insights from data effectively; intelligent automation is the answer!”

Michael Mellinghoff, TechFluence
Future of Finance Forum participant



Safe bank

“There is no doubt that AI will have an impact on customer service. The best systems will be designed so that there is seamless interplay between virtual assistants and humans, but humans will still play an essential role in an AI-powered customer service world.”

Nils Lenke, Nuance

Future of Finance Forum participant

AI also has the potential to make banks more safe, reliable and adaptable than they are today.

Consider security. While there is no doubt that cyber criminals will also be looking at AI techniques, we believe that AI offers more possibilities to vastly improve the means banks have for combatting cyberattacks. Unlike today’s methods for detecting computer viruses, for example, which rely on first knowing what the virus looks like, AI-driven cyber security systems can fight unknown threats – learning to recognize the ‘normal’ state of a bank’s IT environment and then, in ways similar to the human immune system, scanning for and combatting anomalies.

AI-enabled systems can do similar things to fight old-fashioned ‘analog’ crime as well. For example, these systems can better learn employees’ routine behavior and then flag anomalies, perhaps indicating fraud, rogue

trading or various kinds of illegal collusion. AI can also be used for stronger authentication procedures, helping banks combat identity fraud, and it may also be used to safeguard banks’ sensitive data, among other things by keeping track of where it’s stored and who has access to it – an increasingly difficult chore in today’s highly digitized world.

AI will also give banks far better tools for assessing risk, whether on a large scale – the aggregate risk faced by a bank as a whole – or the risk inherent in individual transactions. This will make banks safer too.

Smart bank

As well as safer, AI has the potential to make banks smarter.

By learning how markets behave, and providing improved market intelligence, more profound market insight and better risk assessments, AI can help banks offer deeper, broader and altogether smarter investment advice.

By learning how humans behave, AI may also help bankers make more rational individual decisions. An AI system that learns a trader’s behavior and performance over time, for instance, might help that trader avoid unhelpful emotional biases and identify reoccurring (yet previously unknown) blind spots. As the current trend in AI-enabled algorithmic trading shows, intelligent machines can also learn to be traders themselves. We have already seen the launch of the first fully automated hedge fund.⁵ It’s not likely to be the last.

⁵ ‘The Rise of the Fully Automated Hedge Fund’ (2016). See: <https://www.wired.com/2016/01/the-rise-of-the-artificiallyintelligent-hedge-fund/>

Perhaps the most fundamental benefit will stem from access to information. While computers can analyze large sets of data, as we touched on above, this data has generally been structured: that is, has been in some form, like a table or database, that a program can readily digest.

Vast troves of information about our world is however contained in unstructured form: books, news articles, emails, videos, the records of phone conversations. AI-enabled systems will soon be able to devour and understand such data too – and derive insight from it.

We are already seeing this today. Sentiment analysis, for example, is an area of AI where systems gauge what investors are feeling about a subject by reading blog posts and news releases. We think that over time the reliability and validity of these evaluations will increase, and the results will be revolutionary.

AI will also change how clients interact with banks. Clients will increasingly deal with AI-enabled systems when they contact their bank, whether by email, telephone, chat, text message or even when walking into a branch. At first this will not necessarily be direct contact. Early AI-enabled systems will more likely be used to help advisors and support staff in doing their jobs better by augmenting their capabilities. But increasingly, clients will interact directly with machines, either virtually or in person, for example via virtual assistants. The first applications are not yet delivering to our expectations, but if done right, we think many people will hardly realize they are interacting with intelligent machines, and so won't notice the difference.

Most importantly, AI can help banks be smarter about their clients – and so provide them more compelling services. This can happen in a variety of ways. For example, AI can aggregate information about a client from all areas of the bank, so that no matter which services clients are looking for, the bank will “know” who they are and what they want. As we have seen, AI will also help clients more easily interact with their banks, and, as we discuss in the next chapter, will allow banks to provide them with more powerful tools.

“Intelligent automation brings the opportunity for financial services companies to become more efficient, more effective and more customer centric. Key to harnessing such benefits is to understand the subject, meaning and intent of unstructured data and to overlay external data on top of existing internal data.”

Antony Elliott, Zurich Insurance Company
Future of Finance Forum participant

Efficient bank

“Artificial Intelligence when applied effectively in Financial Services will deliver dramatic increases in productivity by following a continuum of automation. That continuum has already started through providing intelligent search over enterprise data but will evolve into all kinds of recommender systems supporting both front office and back office processes.”

Tim Estes, Digital Reasoning
Future of Finance Forum participant

Banks will also look to AI to help them be more efficient. This will likely happen first in the ‘back office’, where we are already seeing intelligent software agents executing manual, easily-defined administrative processes. As these machines become more intelligent, they will be able to undertake more complex tasks, like credit scoring or automated report writing.

We think there are interesting possibilities for employing AI to understand and categorize routine banking work, to reduce workload by utilizing it for low-level cognitive tasks (e.g. categorizing, routing and prioritizing emails), and to automate these procedures by using AI-enabled robotics capabilities. We also think that AI can be used to measure process performance and user productivity, enabling more accurate demand and capacity management. Furthermore, AI can be used to predict operational risk (e.g. late settlements), enabling smaller, more proactive operations.⁶

AI will also help banks be more compliant. Systems that can autonomously monitor and analyze the operations of a bank will also be able to autonomously control these areas, among other things automatically running audits and creating reports with their findings. As compliance is one of the highest costs banks face, these kinds of capabilities could potentially, and proactively, save banks significant amounts of money too.

AI will not increase efficiencies solely through intelligent automation, however. It also has the potential to greatly enhance the capabilities of its human workforce. A machine that can read and accurately summarize documents, or draft contractual agreements from complex negotiations, or even write reports, would be a boon to any knowledge worker. Bankers of all kinds will certainly benefit.

⁶ This is similar to the way the Los Angeles Police Department has been able to combat crime with a smaller workforce by using AI models to predict where crimes will occur and then focusing their resources accordingly. See: G. Mohler et al. (2014) 'Randomized Controlled Field Trials of Predictive Policing'. Published in the Journal Of The American Statistical Association, Vol. 110, June 2014.

The future of smart: How to work with thinking machines

As AI gets better, it will shape our world in a myriad of ways. In this chapter we provide our view of how AI may develop in certain key areas, and what that means for banks.

Androids in pinstripes

Because AI will change how banks work, it will by necessity change the banking workforce.

There is no doubt that AI has the potential to bring radical, intelligent automation to banks. While capable of handling ever-increasing degrees of complexity, in the initial stages at least intelligent automation will likely be used for repetitive processes with clearly defined data sets and clear, testable outcomes. This however applies to vast areas of a bank's operations, from transactions, compliance and security to things like authentication and know-your-customer processes, where checks are pre-defined and can be easily and unambiguously described.

Along with automation, AI will increasingly be used for augmentation – helping knowledge workers to be better at what they do – especially with unstructured data. As touched on above, machines adept at understanding natural language, reading the news and blogs, talking to people and understanding what they hear, will be able to understand increasing amounts of complexity and present it in clear ways to their human collaborators. That will make them increasingly useful assistants, allowing humans to improve the quality of their services to their colleagues and clients. As AI-enabled systems take over more of the routine work, humans will likely have more time for more creative endeavors.

We do not think this means that AI will replace bankers, but it will force banks to re-evaluate what their workforce does. As they make decisions about what to automate and what not, we think there will be many areas where banks will prefer to stay with humans. For example – particularly in light of the fact that banks' data is highly valuable and a starting point for their intelligent automation roadmap – an

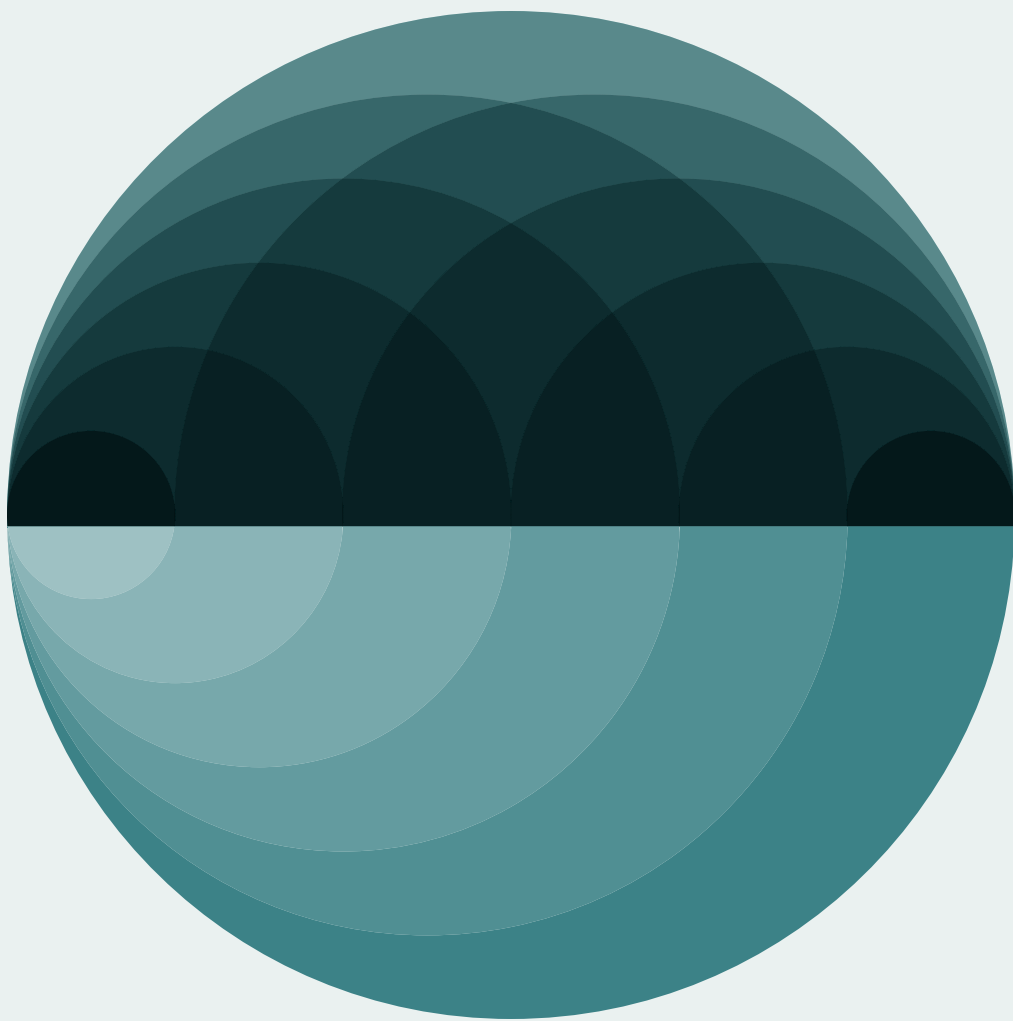
over-reliance on AI may risk giving away competitive insight, especially if the respective operations are outsourced. This raises some interesting questions: Although off-shoring and outsourcing can potentially save costs, could AI-enabled systems potentially make insourcing the better option?

Particularly in the early phases, banks will be concerned with the legal and reputational risks of overreliance on AI systems. They will want human staff to monitor results, check processes, and verify outcomes. We believe that it will take a long time, if ever, for AI-enabled systems to carry out truly creative work, or deal effectively with non-standard situations or situations where there are no clear right or wrong answers. Banks will want human staff to handle such tasks.

But while AI won't replace bankers, it will likely change what they do. That means that different skills will be in demand. Human traits like empathy and cultural sensitivity will become more sought after in applicants, as will a knack for behaving entrepreneurially. New roles will also come into being as we learn to train, control, manage and operate these new systems. Managers and senior decisions makers may need to lead differently too; managing a hybrid AI/human workforce will likely be a different challenge from managing one that is fully human.

“Is AI friend or foe? I see it as a friend. AI can and will help a great deal to improve personalized client experiences and will help companies to further scale the business model.”

Marco Borer, UBS
Future of Finance Forum participant



Tough enough

As banks look to increasingly rely on AI-enabled systems, they will have to consider and weigh a number of fundamental issues around the technology.

Chief among these is the question of “robustness” – or how well the AI performs in terms of stability. Are its results valid? Are they reliable? How well can the AI handle the unexpected?

In the AI world, such questions of performance are even trickier than they might first appear. If we write a conventional computer program to solve a problem, say to carry out a financial transaction, we can examine exactly how it works. But AI-enabled systems do not function like conventional programs. Depending on the approach, they must first learn what to do. That means starting out with basic skills and getting better over time – just as humans do. Do we have a right to expect perfection from such systems when we do not have the same standards for humans?

In AI systems that learn, performance will naturally depend to a large degree on what we teach them. AI-enabled systems that work from models of the world will depend on us to ensure these models are accurate, and that the data we provide them is correct and properly labelled. That is not always easy for us to deliver. They will also assume that the models of the past we provide them will be useful for dealing with future problems. Yet we ourselves cannot be sure of this.

Dealing with the unexpected is a particular issue with AI. To be robust, systems must be able to function with less than perfect information (something humans are often quite good at). One of the most important properties of any AI will therefore be “graceful degradation”: the ability of an AI-enabled system to keep functioning and producing results even if partially damaged or constrained by having not fully understood.

The question of robustness is also closely linked to the question of liability. If we entrust ever-more important decisions to machines, who is liable for the machine’s mistakes? Who should own the knowledge used to train the machines? And who has the right to any new intellectual property created by joining an external firm’s algorithm with a bank’s data?

Furthermore, unlike classical analytical systems, many AI approaches involve weighing probabilities: they do not claim to give you a correct answer, just the most probable one. That means there is always a small probability that the answer will be wrong. Will we be able to accept such error rates, and if so under which conditions?

Decision-making will therefore also be a major issue. Due to the nature of many AI approaches it is not always easy

to know how a certain decision gets made (just as the process of human decision-making is also often inscrutable). Transparency in decision making will likely be an issue if banks want their AI systems to be trusted. For example, if a loan application is denied, clients may want to know why.

And so might the regulator. Today, the entire regulatory framework of banks is based on supervision and control. Banks must be able to show how they achieve their results. But in an AI-enabled world, how do we check that our machines learn what they should and make the best decisions for the customer? And with the increasing use of smart contracts (that may be AI enabled), the dimension of automatically applied AI on blockchain becomes a new dimension for regulators, too. We think such issues will be tricky to resolve as AI technology matures.

“A reliable AI system is one that can say, I don’t know.”

Marco Zaffalon, IDSIA
Future of Finance Forum participant

Stepping stones

While we think AI will play a significant role in financial services, the path to the AI future will not be straightforward; banks can expect to face many hurdles along the way.

We have already touched on several of these: AI will have to be robust and compliant. Banks and regulators will need to work together to agree on prudent rules that protect consumers and society without stifling innovation. Issues of liability will also have to be settled so that banks, their partners and other stakeholders have clarity on what their risks and responsibilities are.

There will be other hurdles as well.

AI promises great benefits but it also causes anxiety. To gain acceptance for AI, banks will have to do a good job of communicating its benefits, while being clear about the risks, both to their workforces and to their clients. AI may mean that clients are asked to consent to banks using their data in new ways, which could make them think anew about their relationship with their banks. Issues around cross-border movement of data, already a complex subject in today’s world, are also likely to take on new dimensions in an AI-enabled environment.

Acceptance will be driven by a number of factors. If AI helps banks provide a better service at a lower fee, clients will likely favor it. The same can be said if AI-enabled systems prove easier and more convenient to use than other solutions. Banks should look to ensure that both these conditions hold true.

Trust will also be fostered by good results. Clients should always understand how decisions are made or advice arrived at, and should always see that the AI is acting in their best interests – not those of the bank. As in any situation, such trust is hard to earn, but very easy to lose: assuming AI operates effectively, there should be no reason for the client to mistrust it, as the service should be indistinguishable, if not better, than it would be with a human.

Learning to crawl

While working to overcome these hurdles, we think banks and other financial services organizations will need to consider how they want to develop and implement AI technology. We believe a sensible pathway begins with working on individual use cases, and that broad-based AI-based platforms should follow later.

Repetitive processes that can be broken down into clearly defined steps will be the most obvious candidates for AI-enabled automation. Similarly, we think banks will look at data rich/decision poor use cases first, before moving on to those with high degrees of uncertainty and requiring complex reasoning.

We think it logical and therefore likely that financial services organizations will prefer low-risk use cases at the outset. As they become more familiar with and confident in the technology, they will move to the higher-risk, higher-payoff areas. There should be many opportunities for the latter.

We think, for instance, that AI could catalyze a reversal in the offshoring and outsourcing trend. That's because, as we hinted above, it can potentially offer the cost reductions typically associated with outsourcing while at the same time providing heightened control over valuable data by keeping operations in-house.

The insights generated by intelligent machines will also likely become a competitive advantage for banks, perhaps even products in themselves. This will further encourage the development of proprietary systems, offering significant benefits on both the cost and revenue sides of the equation while improving the quality of work human employees can offer.

Indeed, we ultimately see competitive positioning in financial services pivoting on the quality and reliability of AI solutions, and as intelligent automation driven by AI has the potential to benefit both the human and automated aspects of the business model, debate on how virtual workforces should be managed will likely emerge.

It is difficult if not impossible to say how long this might take. The history of AI is full of predictions that turned out to be off the mark. But no matter how long the journey is, we are confident that it indeed will be made – and that the impact will be significant.

“Financial services players must embrace Intelligent Automation in order to stay relevant. Intelligent Automation gives financial firms the mechanism to develop real straight-through and cost efficient processes – these will be critical to stay competitive in the digital financial world of the future.”

Giulia Fitzpatrick, UBS
Future of Finance Forum participant

The seventh sense: AI comes to venture capital

The venture capital (VC) industry is a funny beast. Experts at investing in cutting edge technology, venture capitalist firms have been slow to employ cutting-edge technology themselves.

This is particularly true in the way they make investment decisions. Although traders and fund managers routinely use sophisticated data analysis tools to help them evaluate traditional investments, venture capitalists still like to be known for – and proudly claim they rely on – their powers of intuition and their sixth sense about what constitutes a good investment.

While there are some with a knack for this, the future is likely to look different. A number of firms are already now using predictive analytics – a data analysis approach that often makes use of various AI techniques like machine learning – as a way to help them to not only spot winners, but equally important, to spot losers masquerading as winners. There are good reasons to think that VCs will find other uses for this and other AI-reliant technologies too.

The problem with using traditional investment analysis techniques on VC decisions is that, while the factors that drive growth in an existing business are relatively well known, and data easy to find, it is much harder to predict which innovations are likely to be successful. This is particularly so in new markets that are not yet well understood or documented, and where it can be difficult if impossible to find robust patterns and significant correlations in whatever data does exist.

Thanks to its sophisticated statistical techniques and models, predictive analytics can uncover these kinds of patterns that traditional analytical techniques may miss. Once it has access to the right data, even if it is scant or if it is unclear exactly how the data is relevant, predictive analytics employs techniques to derive meaningful information. Such systems are also capable of using more varied types of data as input, which can also help bolster reliability. And with machine learning, outcomes can improve over time as the algorithms learn from their previous experience.

In future, many Silicon Valley venture capitalists may themselves be made of silicon.

Necessary development: The UBS view

It is hard to deny the potential of AI.
The time for banks to start taking advantage is now.

An important role

At UBS we believe that AI has an important role to play in financial services, and that we will see banks adopting AI-enabled processes and systems for a wide variety of areas. This is first and foremost because it will help them be better bankers. We believe firmly that the future of banking lies in relationships and in the valuable services that banks can bring to clients, whether individuals or organizations. We believe that AI will allow us to free our people from routine work and allow them to concentrate on these more creative, value-added services. AI will also provide our people tools to help make them more effective at delivering them.

Another reason is that, to a certain extent, banks have no other choice. Our world is becoming so complex and data-driven that in our industry – as in many other industries – we need much more intelligent tools to harness our information and to put it to work. Banks, for instance, have a duty to their clients and to society to keep on top of the complexity of financial markets, whether for investment or risk mitigation purposes, and will find it increasingly difficult to do so without AI techniques.

The positive side of the coin is that AI will allow banks to provide better products and services at lower cost to a wider range of clients – better advice, better security, better information, and more tools to empower clients to inform themselves, understand the financial world, and carry out transactions on their own.

There is no doubt that banks will be drawn, in many cases, to AI-enabled solutions by their promise of increased efficiencies and reduced costs. These are worthy goals at any time for any business. For banks facing revenue challenges and sticky costs, they are a necessity. While AI will not come cheaply at first, over the long term it seems to us to be one of the few viable means to generate sustainable margins. We owe it to our customers and shareholders to do just that.

We make no secret that a certain portion of cost-savings will come from reducing staff numbers. While we are very

much aware of, and sensitive to, the societal implications, much of AI will be used to automate back office and transactional processes that have been under severe margin pressure for a long time. With or without AI, banks will be looking to automate or restructure much of these capabilities: many of these jobs would likely be leaving banks anyway.

We think that AI will increasingly become a competitive advantage for banks. At UBS, we are moving prudently but swiftly to understand how AI best works, making moves to roll out solutions where possible. And given regulatory obligations, our developments in this space are respectful of client confidentiality agreements and all other compliance considerations.

This won't necessarily be easy. Today's AI is relatively expensive, potentially complicated, and comes with a degree of uncertainty attached, particularly as there is a risk of complex legacy data diluting the potential of the technology.

There is no doubt that banks will need to work more closely with experts in this field. One way is to hire on experience from other sectors, although this is not straightforward considering today's intense competition for technologists. Another way is for banks to partner with universities, the fintech community and centers of research to help source talent. And if they give the subject the necessary attention, there is also no reason why banks cannot become leaders and innovators in this area in their own right.

Ultimately, deploying AI will mean rethinking large parts of how banks run their businesses. This could lead to a temptation to wait and see how the technology develops. In our view, working with AI should be an iterative process. Instead of waiting for perfection and potentially missing opportunities, we think banks and other financial services organizations should significantly engage with AI as soon as they can.

“With robotic process automation (RPA) becoming more of a commodity and AI-powered cognitive automation being adopted quicker, intelligent automation will scale throughout the enterprise much faster in 2017 than expected. It will be the single most powerful capability that operations – particularly in banking – have to differentiate both their P&Ls and their customer service delivery.”

Max Yankelevich, WorkFusion

First steps

At UBS we have had a significant interest in AI-enabled intelligent automation for some time, intrigued by its potential to provide innovative new front-to-back solutions in areas like client interaction, asset management and research, as well as in areas that will help us improve operational efficiency, effectiveness and controls.

Our interest is not just academic. With numerous robots in place, we have already automated and continue to roll-out simple automation processes. And we have already carried out a number of active pilots, some of which can serve as good examples of how AI can further help our operations and offering.

In the back office, for instance, we are working to integrate new software into our IT department that uses machine learning to automate IT tasks. After being taught specific knowledge items, the software can take over routine tasks like resetting passwords and resolving simpler IT issues. Over time, as it learns more about our set-up, this software can take over more of our mundane but essential IT processes.

In this way, the new software also becomes an IT knowledge database, making it easier to share information about processes and functions across the IT organization, as well as ensure that IT knowledge is kept in-house and is not lost when an employee leaves. We expect this to allow us to free up our developers and systems engineers to work on the more difficult challenges, and to have time to innovate and work on future solutions.

On the client side, we are piloting an AI-enabled service called “Ask UBS” that runs on Amazon’s virtual assistant, Alexa. With it, anyone having Amazon’s Echo speakers can ask questions on finance-related topics; things like the performance of the NASDAQ or what is meant by the term “yield curve.”

Using UBS expertise and AI, the service can autonomously answer this and a wide variety of other finance-related questions. Although still in an early stage, we hope to learn from “Ask UBS” about what works and what does not with virtual financial assistants, and understand better what our clients expect from them.

Furthermore, UBS is also exploring how to combine behavioral finance and data science to identify and remedy behavioral biases in the investment process of institutional portfolio managers. The goal here is to improve investment returns to our clients by combining the best of human and machine decision making.

Using machine learning and AI techniques to identify behavioral tendencies, isolate the behaviors that are creating return drags and attempt to remedy them in real-time, we found that machine learning methods performed better for this purpose than traditional models because they better executed the desired investment strategy. For example, a value-oriented portfolio manager will likely always prefer value stocks, but there is not necessarily a relationship between the value of a stock and the likelihood of this portfolio manager buying into it. Through an AI solution we found that predefined investment strategies were better followed by machine learning models.

This experience has taught us that the application of AI techniques to investing created a new and differentiated way of looking at our investment process. We are not stopping here but continue to innovate and look for new ways to apply data science to our investment process to deliver better and more sustainable results.

I'm good for it: Credit scoring through social media

In 1970 the banks of Ireland were closed for six months by a strike. Since people couldn't make withdrawals, there was soon a shortage of cash. But the economy did not come to a halt. Instead people began to use checks and even IOUs as an alternate form of currency, exchanging them at stores and pubs and among each other. This impromptu credit system worked because the Irish economy was mostly local – the people lending to each other knew each other personally and so could easily decide who was creditworthy and who was not.⁷

Reputation can be one of the most powerful means of identification and credit scoring. But reputation only works in communities where people know each other personally. It doesn't seem viable on a regional or global level. Or at least it hasn't until now.

Thanks among other things to AI techniques, companies are developing ways of using reputation as a means of deriving credit scores on a large scale by mining the great stores of reputation-relevant data that people generate online.

Customers seeking loans in this way allow credit-scoring companies to follow them on their social media sites, as well as grant access to their browsing, phone and online payment histories. The companies then apply various big data, machine learning and other AI techniques to generate credit scores based on the person's network and behavior.

This may sound intrusive. But for the millions of people in developing countries who have no or little access to traditional banking it can be their only means of generating a credit history. As such, it is a welcome development.

Just as an Irish publican in 1970 could make a snap credit decision based on what he already knew about his customer, intelligent machines may in future make informed decisions about our creditworthiness, based on the one thing we, at least in theory, have full control over: our behavior.

7 D. Birch (2014) 'Identity is the New Money'.

Afterword

Through collaboration with IDSIA, this paper has explored the current dynamics and potential future of artificial intelligence and intelligent automation in financial services.

In our view – and far from the opinion that intelligent machines will enslave us humans – intelligent automation will likely become integral to our professional and personal lives; clients, colleagues, our business, and society in general are all likely to benefit greatly.

By providing deeper and more timely information, and facilitating more personalized, on-demand services, we could free employees from repetitive and laborious work on the one hand, and generate greater productivity from AI-derived, higher-order, outputs on the other.

And even though thinking machines may do more work for us, this does not mean there will be no more work for us to do. Like what happened in previous industrial revolutions, this will similarly mean that the type of work we do changes. We actually think that in an AI-augmented workplace, people may find their work to be much more interesting and fulfilling than before, as AI will likely enhance human capabilities.

Now is the time we need to significantly engage with what automation technology has to offer. Unprecedented and growing levels of structured and unstructured data, exponential computer processing power, more convenient and cheaper data storage, and machine learning capabilities continue to converge to offer front-to-back opportunities that banks and other financial services organizations should seize.

If intelligent automation technology develops as we expect, it will not only offer a more efficient banking machine, but will likely provide an increasing number of clients more compelling, more insightful services to help us and them understand and manage their financial interests: we all stand to gain.

While the next steps are not (yet) clearly defined, we must be conscious that if banks and other financial services providers do not harness intelligent automation potential, there are a number of fintech enterprises who probably will.

Understandably, there are also regulatory and security challenges to overcome. As with any potentially game-changing development, UBS is making progress in understanding the full practical applications of the technology we are concurrently testing and deploying.

Although we are convinced we are fully justified in continuing with our intelligent automation journey, several pertinent questions remain debatable: How can and should we operate with a hybrid workforce? With the efficiency-gains on offer, alongside the heightened value of information, will this spur mass insourcing? And how can we deploy AI-based solutions in a way that maximizes commercial returns while minimizing detrimental effects on society?

Definition of the problems and challenges, and an in-depth scoping of solutions is a sensible place to start. This is a key reason for the UBS Future of Finance Forums. At these events, and through the corresponding white papers, we bring together leaders and experts from around the world to look at how the fourth industrial revolution may play out in general, and in financial services in particular.

We hope you have found this paper useful, and would be delighted to continue the discussion.

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Workfusion

Tom Edwards

Monocle

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Zurich Insurance Group

Tim Estes

Digital Reasoning

Walter Farkas

ETH Zurich / AAAccell

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UBS

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Eyeware

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IDSIA

The Swiss artificial intelligence lab IDSIA (Istituto "Dalle Molle" di Studi sull'Intelligenza Artificiale) is a non-profit oriented research institute for artificial intelligence. Since 2000 it has been an institute of the Università della Svizzera Italiana (USI) and the University of Applied Sciences and Arts of Southern Switzerland (SUPSI). IDSIA focuses on machine learning, big data/data mining, probabilistic methods, operations research, and robotics. The 60 colleagues include professors, postdoctoral researchers, PhD students and software engineers. IDSIA carries out fundamental research as well as applied research in collaboration with companies and public entities. In 2016, IDSIA was awarded the renowned Swiss ICT Special Award with the acknowledgement that, "it represents one of the best research institutes at the international level in the field of bio-inspired artificial intelligence, and Swiss companies directly benefit from its achievements.

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