

ARTIFICIAL INTELLIGENCE IN PRACTICE

HOW **50 SUCCESSFUL COMPANIES**
USED AI AND MACHINE LEARNING
TO SOLVE PROBLEMS

**BERNARD
MARR**

WITH **MATT WARD**

WILEY

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This edition first published 2019
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Registered office

John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom

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A catalogue record for this book is available from the Library of Congress.

A catalogue record for this book is available from the British Library.

ISBN 978-1-119-54821-8 ISBN 978-1-119-54896-6 (ePDF)

ISBN 978-1-119-54898-0 (ePub)

10 9 8 7 6 5 4 3 2 1

Cover Design: Wiley

Cover Image: © mattjeacock / iStock.com

Set in 11/14pt MinionPro Light by Aptara, New Delhi, India

Printed in Great Britain by TJ International Ltd, Padstow, Cornwall, UK

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INTRODUCTION

One thing is very clear, artificial intelligence (AI) is going to change our world forever. And the change is likely to be more profound than most people realize today. No matter what job you are in, no matter what business or industry you work in, AI is going to augment, if not completely transform, it.

AI is giving machines the power to see, hear, taste, smell, touch, talk, walk, fly and learn. This in turn means businesses can develop completely new ways to interact with their customers, offer them much more intelligent products and service experiences, automate processes and boost business success.

Having said that, we also know there is a massive amount of hype and confusion about AI. Some see it as the ultimate threat to our civilization, while others believe AI is the savior that's going to solve humanity's biggest challenges, from tackling climate change to curing cancer. The aim of this book is to cut through the hype and scare-mongering, and provide a cutting-edge picture of how AI is actually being used by businesses today.

By sharing some of the latest and most innovative real world use cases from across many industries, we hope to demystify AI while at the same time inspiring you to see the immense opportunities AI is offering. We have written this book for anyone who would like to better understand AI and have therefore tried hard to keep the technical details to a level anyone can understand. At the same time, we have

attempted to include just enough techie stuff to make it informative for people who already work in the field of AI.

In this book, you will of course gain insights into how some of the AI giants such as Google, Facebook, Alibaba, Baidu, Microsoft, Amazon and Tencent use it, but you will also learn how many traditional incumbent companies across most industries as well as innovative start-ups use AI. Our hope is that this will provide a realistic picture of the current state of the art: where the AI trailblazers are rolling full steam ahead, leaving many traditional businesses behind in the starting blocks; where traditional businesses are working hard at reinventing themselves and using AI to stay competitive; and where start-ups are using AI to challenge both the AI trailblazers and traditional businesses.

The Most Powerful Technology Of Mankind

AI is the most powerful technology available to mankind today and the biggest mistake anyone can make is to ignore it. Leaders of nations and businesses alike are seeing both the magnitude of opportunities AI brings and the risks of being left behind in the AI goldrush.

In the United States, the White House has released numerous policy documents that emphasize the strategic significance of AI. In 2016, under President Barack Obama, the White House issued the first report “Preparing for the Future of Artificial Intelligence”,¹ which laid the foundation for a US AI strategy. In 2018, under Donald Trump, following an AI summit at the White House, the administration issued “Artificial Intelligence for the American People”² in which President Trump states: “We’re on the verge of new technological revolutions that could improve virtually every aspect of our lives, create vast new wealth for American workers and families, and open up bold, new frontiers in science, medicine, and communication.” The goal of the US Administration is to maintain American leadership in AI by accelerating AI research and deployment, and by

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training the future American workforce to take full advantage of the benefits of AI.³

Russia's President Putin said: "Artificial intelligence is the future, not only for Russia, but for all humankind. [...] Whoever becomes the leader in this sphere will become the ruler of the world."⁴ China has arguably developed the most ambitious plan to make use of AI with a goal of becoming the world leader in AI by 2030.⁵ In Europe, the European Commission released its AI strategy in 2018, in which it states: "Like the steam engine or electricity in the past, AI is transforming our world, our society and our industry. Growth in computing power, availability of data and progress in algorithms have turned AI into one of the most strategic technologies of the 21st century. The stakes could not be higher. The way we approach AI will define the world we live in."⁶

Business leaders agree. Amazon CEO Jeff Bezos believes we have entered the "golden age" of AI that allows us to solve problems that once were the realm of sci-fi.⁷ Google co-founder Sergey Brin said: "The new spring in AI is the most significant development in computing in my lifetime"⁸ and Microsoft CEO Satya Nadella calls AI the "defining technology of our times".⁹ The founder and executive chairman of the World Economic Forum, Klaus Schwab, together with many others, believes that AI (especially when combined with all other technological innovations) has triggered a fourth industrial revolution that is going to transform all parts of business and society.¹⁰

What's Artificial Intelligence? The Rise Of Deep Machine Learning

AI is nothing new and nothing magical. The first developments in AI date back to the 1950s. AI refers to the ability of computer systems or machines to display intelligent behavior that allows them to act and learn autonomously. In its most basic form, AI takes data, applies

some calculation rules (or algorithms) to the data and then makes decisions or predicts outcomes.

For example, the data could be images of handwritten words, letters or numbers. The algorithm would be a computer program written by a human that contains rules such as the common shapes of each letter and spacing between words. This then allows a computer to analyze scanned images of handwritten text, apply the rules and make predictions about which letters, numbers and words it contains, enabling machines to recognize handwriting. This type of AI has been used, for example, by the US Postal Services to automatically read addresses on letters from as early as 1997. For narrow applications this kind of AI worked well.

This rule-based AI runs into difficulties when tasks are more complex or when we humans can't easily explain the rules and therefore can't program them into algorithms. Speaking our language, walking around and recognizing a friend in a crowd are all examples of skills that we have acquired through experience but for which we can't easily explain the rules.

We have learned those skills via a network of neurons in our brain that have been programmed to, for example, recognize a face by looking at the face from lots of different angles over a period of time, or we have learned how to walk and talk through trial and error. In modern AI, we basically replicate this process using artificial neural networks and instead of having humans programming the rules, we let the machines create the rules by themselves, similarly to how our brain learns from experience. We refer to this as machine learning.

In machine learning, we train AI with data by, for example, feeding it thousands of images that either contain human faces or don't contain human faces. The computer then takes in the information and creates its own algorithm either completely independently (unsupervised machine learning) or with help from humans (supervised

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or semi-supervised machine learning). When machine learning uses multiple layers of artificial neural networks to learn from training data (which makes them more powerful), we refer to it as deep learning.

Deep learning has given us many of the recent advances in AI, such as the ability for computers to see and recognize what or who is in an image or in a video (machine vision). Or it has given machines the ability to understand and reproduce written text or spoken words, which we call natural language processing and see in website chatbots or home smart speakers like Amazon's Echo.

There are two key reasons why deep learning is thriving today:

1. We have data: Data is the raw material that is fuelling AI and in today's big data world we are generating more data than ever before. The digitization of our world means that almost everything we do leaves a data trail and we are increasingly surrounded by smart devices that collect and transmit data. This is causing exponential growth in the volume and types of data we can now use to train AI.
2. We have computing power: We now have the ability to store and process vast amounts of data. Breakthroughs in cloud computing allow businesses to cheaply store almost unlimited volumes of data and use distributed computing to analyze big data in near real time. What's more, advances in chip technology mean AI computations can now be performed on devices such as smartphones or other smart connected devices. We refer to this as edge computing on Internet of Things devices.

We humans continuously learn and improve through experience. This "learning by doing" approach can now also be replicated by machine learning algorithms via reinforcement learning. Similarly to how toddlers learn to walk by adjusting actions based on the outcomes they experience, such as taking a smaller step if the previous

broad step made them fall, AI uses reinforcement learning algorithms to determine the ideal behavior based upon feedback from the environment. Reinforcement learning gives machines (for example, robots) the ability to walk, drive or fly autonomously. Many leading-edge applications of machine learning combine deep and reinforcement learning techniques.

If you would like to learn more about any of these fascinating topics, head to www.bernardmarr.com where you can find hundreds of articles and videos explaining and discussing everything you need to know about AI and machine learning.

Artificial Intelligence Opportunities In Business

There are three key use cases for AI in business, which can overlap to some degree, but help to segment the opportunities. Businesses can use AI to: (1) change the way they understand and interact with customers, (2) offer more intelligent products and services, and (3) improve and automate business processes.

Customers: AI can help businesses better understand who their customers are, predict what products or services customers are likely to want, predict market trends and demands and provide more personalized interactions with customers. In this book, we will look at companies like Stitch Fix and Facebook, which use AI to really get to know their customers.

Products and services: AI can help businesses create more intelligent products and services to offer to their customers. Customers want more intelligent products such as smarter phones, smarter cars and smarter home devices. In this book, we will look at how Apple, Samsung and car companies such as Tesla and Volvo use AI to create smarter products and we explore how others like Spotify, Disney or Uber use AI to deliver more intelligent services to their customers.

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Automate processes: AI can improve and help automate business processes. In this book, we will look at examples such as JD.com that is using autonomous drones, automated fulfillment centers and delivery robots to transform its retail operations. We will also look at how AI can automate medical diagnosis in the Infervision and Elsevier case studies, and even the pizza quality checks at Domino's.

The Strategic Use Of Artificial Intelligence In Business

Exploring the applications of AI in any business will often lead to a business model refresh or even a complete transformation of the business approach. It is important that companies don't use AI to automate and improve a business model that is no longer relevant during the fourth industrial revolution.

The starting point for any use of AI should be an AI and data strategy that identifies the biggest strategic opportunities and threats for any business and then pinpoints the most impactful applications. It is important to recognize that simply experimenting with AI around the edges is not going to deliver the necessary effects on business success.

Artificial Intelligence In Practice

In this book, you will find 50 company use cases and within them even more leading-edge examples of how these companies have used AI in practice to solve real world problems. We have divided the book into five parts.

Part 1 contains case studies from the AI trailblazers. These tech companies are the ones that have grabbed hold of the AI opportunities and are running with them to transform industries and deliver mouth-watering business results. Most of them have made innovative applications of AI part of all aspects of their business and therefore provide great insights into the art of the possible.

We could have segmented the remaining case studies in different ways, by AI application or by industry. Based on the feedback we received, we opted for the following industry segmentations.

In Part 2 we look at retail, consumer goods and food and beverage companies. In Part 3 we explore how media, entertainment and telecom companies use AI. Part 4 looks at the services sector, including financial services and healthcare. Finally, in Part 5 we look at manufacturing, automotive, aerospace and industry 4.0 case studies.

You can simply read this book cover to cover or dip in and out to explore the case studies or industries you are most interested in. We hope you will enjoy it!

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Part 1
**ARTIFICIAL
INTELLIGENCE
TRAILBLAZERS**

1

ALIBABA

Using Artificial Intelligence To Power The Retail And Business-To-Business Services Of The Future

Alibaba Group is a Chinese multinational conglomerate that operates the world's largest e-commerce network through its web portals, which include Alibaba.com, Taobao, Tmall and Ali Express. With global sales that dwarf those of Amazon and eBay combined,¹ the business took what it learned from building a global online retail platform and has applied it to enterprises in just about every area of business and technology. Alibaba's success in delivering e-commerce and retail services, electronic payment, as well as business-to-business cloud services, has earned it a market cap in excess of US\$500 billion.

Its customers use artificial intelligence (AI) tools to help them find what they want when they shop at its online portals, and as one of the world's largest cloud computing providers it also licenses platforms, tools and cloud services to other businesses to help them leverage AI.

Beyond that, Alibaba is rolling out AI across the wider society, with projects involving turning entire cities into "smart cities". They are also planning on revolutionizing China's (and perhaps the world's) agricultural industries to ease the burden of feeding a growing population.

How Does Alibaba Use Artificial Intelligence?

The Chinese government has strongly supported efforts by businesses to adopt AI, clearly believing that it has enormous potential for driving economic growth. Its goal is to foster a \$1 trillion industry and be the world leader in AI by 2030.²

This, combined with the fact that the country's enormous population gives companies access to huge amounts of data on customers' lives, makes the country a fertile ground for AI development.

Alibaba's e-commerce portals use sophisticated AI to choose which items to display to customers when they visit and search for products they want to buy. It does this by building a custom page view for every visitor, aimed at showing them items they will be interested in, at prices that seem right.

By monitoring customer actions – whether they make a purchase, browse to a different item or leave the site – it learns in real time to make adjustments to these page views to increase the probability of the visit ending in a purchase.

To train its e-commerce portals to show visitors pages that are likely to result in a sale, Alibaba has deployed a form of semi-supervised learning known as reinforcement learning on its Taobao portal.³

Because collecting enough user data to train unsupervised learning algorithms from real-time customer actions would take a long time, and involve real business risks, a virtual Taobao was built, with customer behavior simulated from hundreds of thousands of hours' worth of historical customer data.

This mass of data meant that it was possible for the algorithms to be exposed to a far wider range of customer behaviors, in a far shorter time span.

Alibaba also has its own AI-powered chatbot – Dian Xiaomi – that answers more than 350 million customer enquiries a day, successfully understanding more than 90% of them. These tools are necessary to help it deal with the huge spikes generated by special occasions such as the Alibaba-created “Singles’ Day” shopping event.⁴

Automated Sales Copy

With millions of different items on sale across its sites, Alibaba has invested in automated content generation to ease the burden of writing descriptions for everything it sells. The tools are also available to third-party sellers on its platforms.

Its AI copywriter uses natural language processing algorithms running on deep learning neural networks to produce 20,000 lines of copy in a second.⁵

Traditionally, sales copywriters have had to spend hours researching keywords and click-through rates to understand what is likely to make a customer click their link in a page of product search results. The AI copywriter allows Alibaba and others selling through its platforms to do it at the click of a button.

This is done by creating multiple versions of adverts and running them through algorithms trained on customer behavior data. The system works out which combination of words is most likely to result in customer clicks, and uses them to create its copy.

Cloud Services

Just like Amazon and Google, Alibaba offers artificially intelligent services through the cloud to its business customers. Its cloud service business is the largest of all the Chinese tech giants.⁶

Alibaba’s AI offering is called Machine Learning Platform for AI, which offers solutions for businesses wanting to take advantage of

cognitive computing functions such as natural language processing and computer vision, without the upfront costs of directly investing in infrastructure.

Alibaba's natural language processing technology was the first in the world to beat a Stanford University test designed to assess whether a machine can beat a human at reading comprehension.

In 2018, its deep neural network language processing technology passed the 100,000 question test with a score of 82.44 – narrowly beating the human score of 82.3.⁷

Smart Cities

Alibaba has developed a suite of cloud-based AI tools designed to carry out essential jobs like managing traffic flow, lighting and waste collection in cities where infrastructure is connected through smart online technology.

Alibaba City Brain already tracks and manages traffic flow on every street of Hangzhou, a city with a population of 9.5 million. The system is reported to have reduced traffic jams by 15%⁸ and is soon expected to be deployed in Kuala Lumpur, Malaysia.

City Brain monitors the flow of traffic and builds up models that it can use to predict when congestion is likely to occur. When it recognizes signs that there is a high probability of this happening, it can alter traffic light patterns to speed up or control the flow of traffic, so jams are less likely to form.

Alibaba's AI also powers the smart ticket kiosks at Shanghai's subway stations. The kiosks give customers route information when asked, and check customer identification using facial recognition technology.⁹

Smart Farming

Alibaba has developed an AI system for monitoring farm herds, crops and orchards.

As the world's biggest supplier and consumer of pork, Chinese pig farmers have access to technology that records activity and health levels of herds, automating decision making over when to increase feed or provide animals with more exercise.¹⁰

Facing the challenge of feeding an ever-growing population, the system allows farmers to optimize breeding rates by raising a healthier herd and reducing newborn death rates. The system also has applications in crop growing and land management.

Academy For Discovery, Adventure, Momentum And Outlook

Alibaba's AI strategy is based around distributing its cutting-edge machine learning and deep learning solutions to businesses and customers through its cloud services.

Its business AI platform is delivered through its Alibaba Cloud subsidiary, which operates 18 global data centers. These host the hardware that powers the AI algorithms and data processing technology, which is provided as a service.

In 2017 it announced it would invest \$15 billion over the next three years, expanding its global network of AI research and development facilities.

It calls this program the Academy for Discovery, Adventure, Momentum and Outlook – DAMO – and will involve recruiting 100 researchers for its labs in Beijing and Hangzhou, China, and San

Mateo and Bellevue in the United States, as well as others in Moscow, Tel Aviv and Singapore.¹¹

Research at the labs will focus on machine learning, natural language processing, Internet of Things, human/machine interaction and quantum computing.

Key Challenges, Learning Points And Takeaways

- Alibaba is China's biggest investor in research and development, which has given it a strong start in the race to become the world leader in AI.
- Its model for rolling out AI to millions of customers and businesses is to deploy its services through the cloud. This cuts customer risk and infrastructure cost, while giving Alibaba access to valuable data about how its customers behave.
- By applying technology designed to drive sales at its retail portals to other problems in business and society, it identifies new use cases for AI, within and outside its established business operations.

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