

APRIL 2020

---

# *AI: LEARNING ON THE JOB*

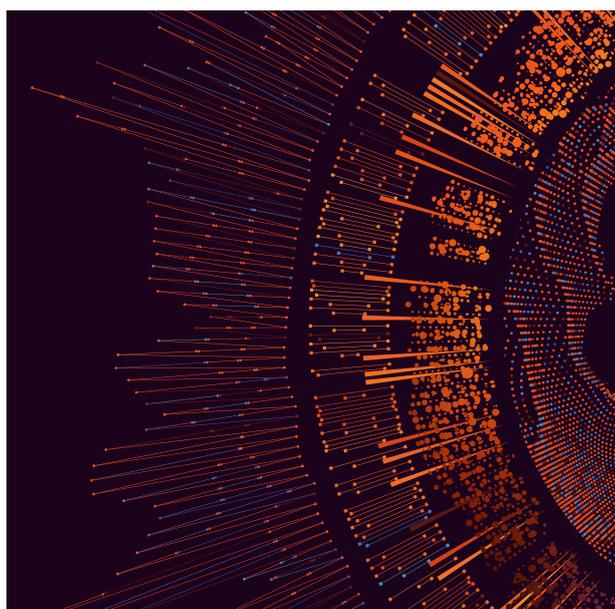
---

*The great data gold rush, plus faster and smarter computer processing, is giving companies superhuman powers of self-improvement*

Unless you're a computer geek, can you really comprehend the potential impact Artificial Intelligence (AI) could have on our lives?

It's likely to be huge. PwC suggests it could add \$15 trillion to the world economy by 2030. Andrew Ng, co-founder of Google Brain, former chief scientist at Baidu, and teacher of machine learning at Stanford University, calls AI 'the new electricity'.

AI has taken significant leaps in recent years, supported by the march of computing processing power. AI-driven algorithms now defeat world champions at games such as chess and its even more complex Asian equivalent, go. The next challenge for the artificial mind is to tackle some of the world's biggest problems in healthcare, climate change and energy efficiency.



## WHY NOW?

How come we're all suddenly talking about AI when it's been around for over 50 years? Three reasons: data, computing power and algorithms.

Data is the fuel of AI and it's now gushing forth freely. We now generate the equivalent of all the data created in 2002 every week. No fewer than 190 million emails are sent every minute, 300 million Google searches are conducted per hour and an estimated 100 billion-plus of TikTok's mini-videos are viewed per day. In China alone, mobile data consumption trebled in 2019.

Computer power has charted a similar path, growing exponentially for decades following the predictions of Moore's Law. It is now incorporated into a myriad of previously analogue devices, and even into the human body.

This in turn, has boosted an application of AI known as machine learning (ML), where algorithms use what they've learned in the past and apply it to new problems.

Algorithms were previously simple sets of instructions – think of a recipe to bake a cake – but ML algorithms changed the rules. Lacking access to the recipe, they can still achieve the same outcome. Instead, the computer is given the key data points and is 'trained' to work out how to produce the cake by itself. In short, ML algorithms dispense with the chore of writing endless lines of computer code to programme a specific outcome.

Therein lies the opportunity. Algorithms can be used to predict virtually anything. Suppose you wanted to predict whether I would venture out of my house tonight. An ML algorithm would describe this challenge as the 'target'. What factors might influence my decision? Perhaps the day of the week, whether my best friend is out, or whether Game of Thrones is on TV. Having defined these so-called 'features', the algorithm needs data points to 'train' with – this is the machine learning bit. The algorithm starts dumb but learns fast:

Data point 1: Monday, friend staying in, GoT is on. Outcome: Stay in.

Data point 2: Saturday, friend is out, GoT is not on. Outcome: Go out.

... and so on and so on.

As more data points are automatically fed in, the algorithm adjusts the weighting and importance of the features. Do this a million times in quick succession and you end up with a model that does an incredible job of mimicking the real-world decision-making process. Add in another datapoint into the model without an outcome, and the algorithm will predict your reaction with high accuracy.

The key attraction of algorithms is their flexibility. With the right data it's easy to set the target to 'what music does this person want to hear next?' or 'what ads should I show to tempt them to buy?'

Long Term Global Growth searches for exceptional businesses that experiment and adapt to incorporate evolving technologies. So naturally, most companies in the portfolio already employ machine intelligence at scale.

## THE ENABLERS

A small number of ‘enabler’ companies is vital to the AI supply chain.

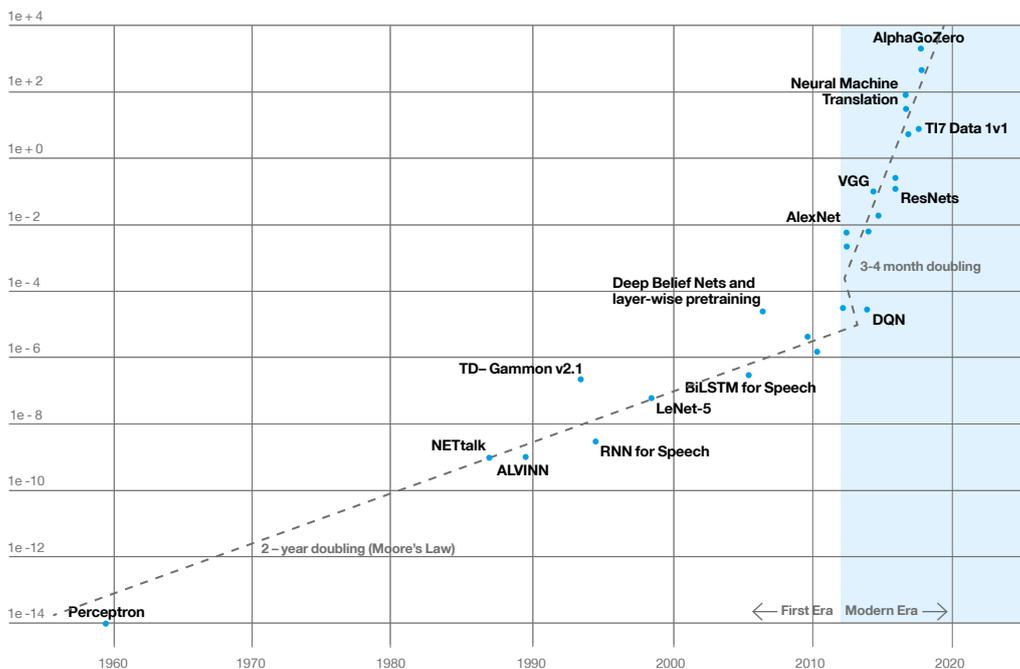
ASML, held in the portfolio since 2017, could be the most important company in the world you’ve never heard of. Without the Dutch manufacturer’s machines etching intricate designs on silicon wafers, the technological revolution would soon stall. ASML makes the machines that produce the ‘brains’ of electronic devices, able to handle the AI workloads as data volumes continue to explode. That’s lucky, as the computing power required to train state-of-the-art AI models has grown over 300,000 times since 2012, shooting past what Moore’s Law predicted.

US firm NVIDIA is another enabler, held since 2016. Its importance in the industry cannot be overstated. Its graphics processing units (GPUs) have evolved into a computerised brain, straddling the exciting intersection of virtual reality, high performance computing and artificial intelligence. GPUs are the single most important items in developing AI applications and they are in demand across the globe. Tencent’s cloud gaming service will soon be powered by NVIDIA chips, meaning complex graphics can be rendered in real-time via an internet connection. The need for gaming consoles will soon disappear.

Alibaba’s and Baidu’s recommendation engines run on NVIDIA chips as well, and Alibaba has recently lauded their success. Click-through rates improved by 10 per cent through use of their chips, bringing instant revenue benefits. China aims to become an AI superpower in the next decade. However, it will rely largely on the technology of two foreign companies to make that a reality.

### Two distinct eras of computer usage in training AI systems

Petaflop/s-days



Source: OpenAI

## THE USUAL SUSPECTS

Not surprisingly, portfolio holdings Amazon, Alphabet, Netflix, and Facebook have been using AI for years. They all use algorithms on their core platforms in generally the same way, as recommendation engines. However, their uses of AI are broadening.

Facebook now uses machine vision to take down nefarious imagery from its platform. Alphabet said in a recent financial report that “machine learning and artificial intelligence (AI) are increasingly driving many of our latest innovations, from YouTube recommendations to driverless cars to healthcare diagnostics”. Amazon wants to put machine learning capability in the hands of every developer and data scientist across the globe. Its end-to-end machine learning service called SageMaker, handily available on Amazon Web Services, is doing just that.

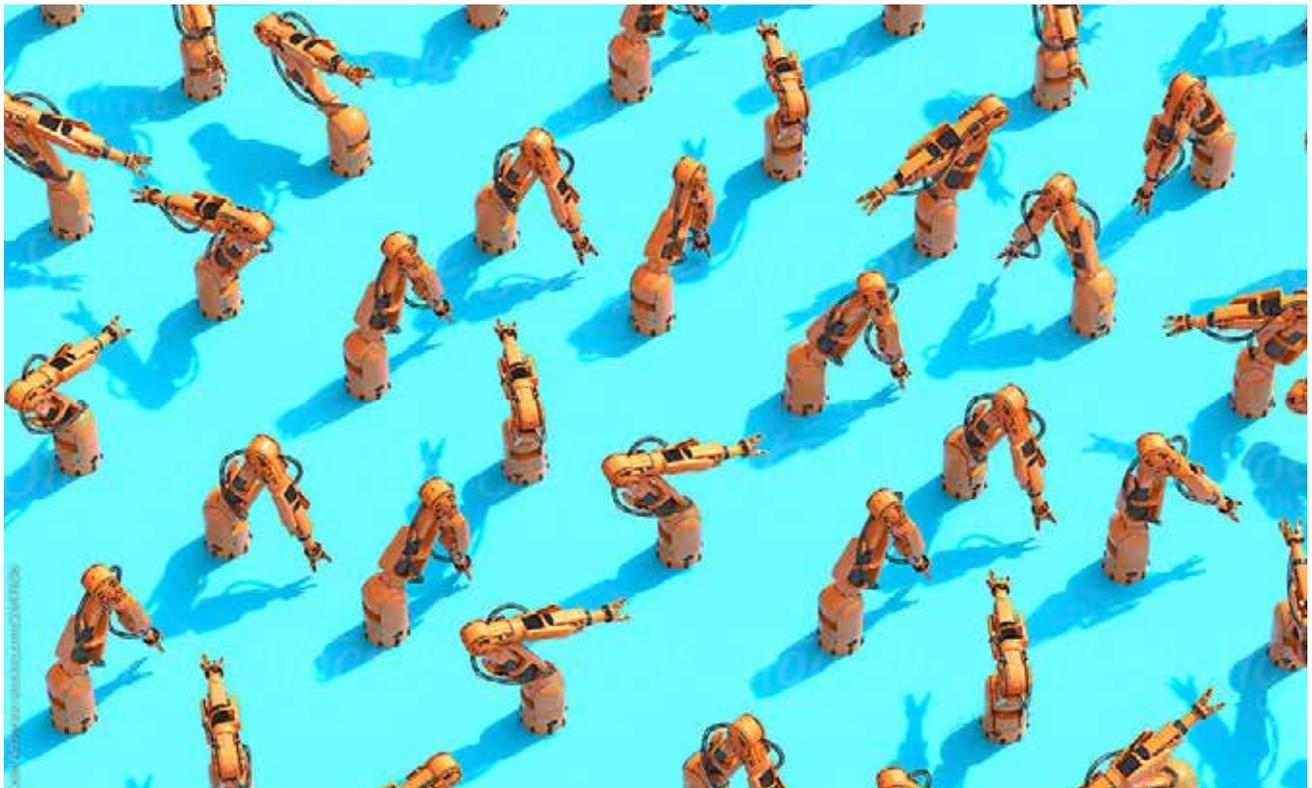
The breadwinner for these firms is still the recommendation engine. Respectively 61 per cent and 76 per cent of the AI workloads of Google and Facebook come from search and newsfeed recommendations. Those weightings tell us where most of their revenues

come from. However, different types of AI, such as natural language processing (voice and translation) and machine vision (images) will only grow in importance.

For example, the number of brands partnering with Amazon’s voice assistant Alexa is growing. In India, KFC now offers a hands-free, cash on delivery, voice ordering service. A novelty for some, but in a country where illiteracy still runs rife, voice creates a channel to reach potentially millions of dormant consumers.

What’s next? Well, how about AI within robots themselves? Amazon held a robot-versus-human ‘picking and placing’ challenge back in 2015. The humans won, naturally, managing to process around 15 times more items per hour.

Fast forward to 2018, and that difference has narrowed to just twice as many per hour. Like most AI systems, picking robots are improving at phenomenal speed. Covariant, a Berkeley-based robot start-up, focusing on warehouse logistics technologies, improved robot accuracy from 15 per cent to 95 per cent in only five months. It’s only a matter of time before human capabilities are superseded.



## TESLA

The long-term opportunity for Tesla has broadened since LTGG's first investment in 2013. Elon Musk's 'Master Plan', penned in 2006, was to create a low- volume car, use that money to develop a medium-volume car at a lower price, and then use that money to create an affordable, high-volume car. With the last step of this plan in train, the focus has shifted to creating self-driving capability for their entire fleet through machine learning.

The self-driving opportunity for Tesla may be seriously underestimated. This is natural as it has little to do with the operational aspects of car production on which most analysts focus. Developing self-driving is mainly a data problem. In simple terms, if enough visual data is collected from the eight 'surround cameras' fitted on every Tesla vehicle, the company's algorithms will eventually be able to perceive the world as we do in real time, and drive from point A to B safely. Tesla now has data from over three billion miles driven using its 'Autopilot' system. It took them four years to get to one billion, and less than a year to double that number. Progress is rapid.

An annual subscription to a fleet of Tesla self-driving vehicles is likely to be a compelling offer. Tesla's margins would look more like those of a software business than of a traditional car company should this come to fruition. Tesla's long-term success has as much, if not more, to do with AI advances than with the mechanics of car production.



© Bloomberg/Getty Images

*Tesla now has data from over three billion miles driven using its 'Autopilot' system. It took them four years to get to one billion, and less than a year to double that number.*

---



Employees work at Pinduoduo headquarters on July 25, 2018 in Shanghai, China. © Visual China Group/Getty Images

## CHINA’S AI SUPERPOWERS

China is committed to becoming the world leader in AI by 2030. With an online population of over 800 million, three times that of the US, large-scale data collection is effortless. This is not surprising in a country where citizens worry less about privacy and censorship. Less than a decade ago, China and the US were developing AI capabilities at similar rates. That is now a distant memory.

In November 2017, China’s Ministry of Science and Technology announced that the nation’s first wave of open AI platforms will rely on Alibaba for Smart Cities technology and Tencent for medical imaging and diagnostics.

Rapid development in China is nothing new. It’s part of the reason why Baillie Gifford recently opened a research office in Shanghai. Many products and services in China now have no US analogue, with some Chinese-born ideas now going global.

<b>Alibaba</b>	Alibaba’s ‘City Brain’ crunches data from cameras, sensors, social media feeds, and government data. Algorithms are then used to predict outcomes across healthcare, urban planning, traffic management, and more. Clearly Alibaba is more than just a leading ecommerce platform.
<b>Tencent</b>	Tencent aspires to becoming a leader in personalised medicine using AI. With around 40,000 medical institutions on its messaging service WeChat, as well as several thousand that accept WeChat payments, Tencent has access to a treasure trove of consumer data to help train its algorithms. Its aspiration to become a digital assistant to all industries may not be so outlandish given the firm’s laser focus on developing AI capabilities. It’s YouTu lab, a leader in machine learning, aims to help them achieve this goal.
<b>Pinduoduo</b>	Pinduoduo (PDD), only five years old but already China’s second largest ecommerce company with over 500 million active users, is using AI to help farmers meet consumer demand. What was a complex supply chain of warehouses, distributors and retailers, has been disrupted and simplified by PDD to give better terms to the farmer. PDD set up Duo Duo Farms to help it gain the necessary skills to sell directly on the platform, without having to rely on layers of intermediaries. Pinduoduo neatly connects farmers (the first mile) directly with consumers (the last mile).
<b>Meituan-Dianping</b>	Meituan-Dianping, the food delivery behemoth, delivers more than 30 million meals per day. It now has over 400 million users on its platform, regularly ordering hot meals. It couldn’t do it without its AI ‘Super Brain’ which integrates real-time computation, offline data processing and machine learning to perform ‘deep sensing’ and build its understanding of the world. All of this results in a better customer experience. Average delivery times have reduced from an hour to 30 minutes in a few years. Not surprising when an abundance of data is collected related to delivery times, pricing and logistics network design.
<b>TikTok</b>	TikTok, the viral video app owned by ByteDance, is an example of how fast development can happen. TikTok supersedes the traditional feed-and-follow model popularised by Facebook and Instagram. With TikTok, AI comes first. Videos go viral on the platform with ease due to large-scale deep learning algorithms pushing content to interested users. The platform is now a global hit, with over a billion users, all from an app not yet five years old.

## **THE ROAD AHEAD**

With AI becoming intrinsic to the strategy and operations of so many LTGG holdings, we should be optimistic about the potential benefits it can offer companies, but also wary of the associated tensions and biases that could creep in along the way. That's why we find our partnership with Cambridge University's Leverhulme Centre for the Future of Intelligence so valuable. It aims to explore the opportunities and challenges of this potentially epoch-making technology, in the short and long term. We look forward to exploring their thoughts on points of tension, such as that between use of personal data to improve services versus respect for privacy and freedom of choice. These issues affect all companies. Solving them is vital to navigating the obstacles that AI could throw up.



---

## RISK FACTORS

---

The views expressed in this article are those of the Long Term Global Growth Team and should not be considered as advice or a recommendation to buy, sell or hold a particular investment. They reflect personal opinion and should not be taken as statements of fact nor should any reliance be placed on them when making investment decisions.

This communication was produced and approved in June 2020 and has not been updated subsequently. It represents views held at the time of writing and may not reflect current thinking.

### **Potential for Profit and Loss**

All investment strategies have the potential for profit and loss, your or your clients' capital may be at risk. Past performance is not a guide to future returns.

### **Stock Examples**

Any stock examples and images used in this article are not intended to represent recommendations to buy or sell, neither is it implied that they will prove profitable in the future. It is not known whether they will feature in any future portfolio produced by us. Any individual examples will represent only a small part of the overall portfolio and are inserted purely to help illustrate our investment style.

This article contains information on investments which does not constitute independent research. Accordingly, it is not subject to the protections afforded to independent research, but is classified as advertising under Art 68 of the Financial Services Act ('FinSA') and Baillie Gifford and its staff may have dealt in the investments concerned.

All information is sourced from Baillie Gifford & Co and is current unless otherwise stated.

The images used in this article are for illustrative purposes only.

---

## IMPORTANT INFORMATION

---

Baillie Gifford & Co and Baillie Gifford & Co Limited are authorised and regulated by the Financial Conduct Authority (FCA). Baillie Gifford & Co Limited is an Authorised Corporate Director of OEICs.

Baillie Gifford Overseas Limited provides investment management and advisory services to non-UK Professional/Institutional clients only. Baillie Gifford Overseas Limited is wholly owned by Baillie Gifford & Co. Baillie Gifford & Co and Baillie Gifford Overseas Limited are authorised and regulated by the FCA in the UK.

Persons resident or domiciled outside the UK should consult with their professional advisers as to whether they require any governmental or other consents in order to enable them to invest, and with their tax advisers for advice relevant to their own particular circumstances.

Baillie Gifford Investment Management (Europe) Limited provides investment management and advisory services to European (excluding UK) clients. It was incorporated in Ireland in May 2018 and is authorised by the Central Bank of Ireland. Through its MiFID passport, it has established Baillie Gifford Investment Management (Europe) Limited (Frankfurt Branch) to market its investment management and advisory services and distribute Baillie Gifford Worldwide Funds plc in Germany. Baillie Gifford Investment Management (Europe) Limited also has a representative office in Zurich, Switzerland pursuant to Art. 58 of the Federal Act on Financial Institutions (“FinIA”). It does not constitute a branch and therefore does not have authority to commit Baillie Gifford Investment Management (Europe) Limited. It is the intention to ask for the authorisation by the Swiss Financial Market Supervisory Authority (FINMA) to maintain this representative office of a foreign asset manager of collective assets in Switzerland pursuant to the applicable transitional provisions of FinIA. Baillie Gifford Investment Management (Europe) Limited is a wholly owned subsidiary of Baillie Gifford Overseas Limited, which is wholly owned by Baillie Gifford & Co.

### **Hong Kong**

Baillie Gifford Asia (Hong Kong) Limited 柏基亞洲(香港)有限公司 is wholly owned by Baillie Gifford Overseas Limited and holds a Type 1 licence from the Securities & Futures Commission of Hong Kong to market and distribute Baillie Gifford’s range of collective investment schemes to professional investors in Hong Kong. Baillie Gifford Asia (Hong Kong) Limited 柏基亞洲(香港)有限公司 can be contacted at Room 3009-3010, One International Finance Centre, 1 Harbour View Street, Central, Hong Kong. Telephone +852 3756 5700.

### **South Korea**

Baillie Gifford Overseas Limited is licensed with the Financial Services Commission in South Korea as a cross border Discretionary Investment Manager and Non-discretionary Investment Adviser.

### **Japan**

Mitsubishi UFJ Baillie Gifford Asset Management Limited (‘MUBGAM’) is a joint venture company between Mitsubishi UFJ Trust & Banking Corporation and Baillie Gifford Overseas Limited. MUBGAM is authorised and regulated by the Financial Conduct Authority.

### **Australia**

This material is provided on the basis that you are a wholesale client as defined within s761G of the Corporations Act 2001 (Cth). Baillie Gifford Overseas Limited (ARBN 118 567 178) is registered as a foreign company under the Corporations Act 2001 (Cth). It is exempt from the requirement to hold an Australian Financial Services License under the Corporations Act 2001 (Cth) in respect of these financial services provided to Australian wholesale clients. Baillie Gifford Overseas Limited is authorised and regulated by the Financial Conduct Authority under UK laws which differ from those applicable in Australia.

---

## IMPORTANT INFORMATION

---

### South Africa

Baillie Gifford Overseas Limited is registered as a Foreign Financial Services Provider with the Financial Sector Conduct Authority in South Africa.

### North America

Baillie Gifford International LLC is wholly owned by Baillie Gifford Overseas Limited; it was formed in Delaware in 2005 and is registered with the SEC. It is the legal entity through which Baillie Gifford Overseas Limited provides client service and marketing functions in North America. Baillie Gifford Overseas Limited is registered with the SEC in the United States of America.

The Manager is not resident in Canada, its head office and principal place of business is in Edinburgh, Scotland. Baillie Gifford Overseas Limited is regulated in Canada as a portfolio manager and exempt market dealer with the Ontario Securities Commission. Its portfolio manager licence is currently passported into Alberta, Quebec, Saskatchewan, Manitoba and Newfoundland & Labrador whereas the exempt market dealer licence is passported across all Canadian provinces and territories. Baillie Gifford Investment Management (Europe) Limited ('BGE') relies on the International Investment Fund Manager Exemption in the provinces of Ontario and Quebec.

### Oman

Baillie Gifford Overseas Limited ("BGO") neither has a registered business presence nor a representative office in Oman and does not undertake banking business or provide financial services in Oman. Consequently, BGO is not regulated by either the Central Bank of Oman or Oman's Capital Market Authority. No authorization, licence or approval has been received from the Capital Market Authority of Oman or any other regulatory authority in Oman, to provide such advice or service within Oman. BGO does not solicit business in Oman

and does not market, offer, sell or distribute any financial or investment products or services in Oman and no subscription to any securities, products or financial services may or will be consummated within Oman. The recipient of this document represents that it is a financial institution or a sophisticated investor (as described in Article 139 of the Executive Regulations of the Capital Market Law) and that its officers/employees have such experience in business and financial matters that they are capable of evaluating the merits and risks of investments.

### Qatar

This strategy is only being offered to a limited number of investors who are willing and able to conduct an independent investigation of the risks involved. This does not constitute an offer to the public and is for the use only of the named addressee and should not be given or shown to any other person (other than employees, agents, or consultants in connection with the addressee's consideration thereof). Baillie Gifford Overseas Limited has not been and will not be registered with Qatar Central Bank or under any laws of the State of Qatar. No transactions will be concluded in your jurisdiction and any inquiries regarding the strategy should be made to Baillie Gifford.

### Israel

Baillie Gifford Overseas is not licensed under Israel's Regulation of Investment Advising, Investment Marketing and Portfolio Management Law, 5755-1995 (the Advice Law) and does not carry insurance pursuant to the Advice Law. This document is only intended for those categories of Israeli residents who are qualified clients listed on the First Addendum to the Advice Law.

