

November 2023

Increasing amounts of data and processing power have driven advances in artificial intelligence. Investment manager Kyle McEnergy considers how companies can take advantage of the resulting new tools and what else may lie ahead.

Your capital is at risk. Past performance is not a guide to future returns.

Malcolm Borthwick (MB): Do you remember the Atari video game breakout? It's the one where you bat a ball against coloured bricks above you. About a decade ago the AI research that DeepMind created a bot and then challenged it to play this game without telling it how. At first the results were terrible. Then they got a little bit better. Then something extraordinary happened. It figured it could carve a route, bounce a ball along the top, and then gain maximum points with minimum effort, therefore demonstrating the ability to discover new knowledge.

Well, today's AI models are lot more capable and they take more to train. One of the co-founders of DeepMind recently said that it takes 5 billion times more compute to train one of today's chatbots than one of its Atari predecessors. So in today's Disruption Week, we'll be talking about the opportunities and challenges AI creates with investment manager Kyle McEnergy.

A universe of opportunity

MB: Hello, and welcome to Disruption Week. I'm Malcolm Borthwick, Managing Editor at Baillie Gifford, and I'm joined by Kyle, who's an Investment Manager here. Before joining Baillie Gifford, he was a physicist in academia, so will bring a different perspective to our conversation. Kyle, it's great to have you with us.

Kyle McEnergy (KM): Thank you very much for having me.

MB: And just a reminder, this webinar will be about 40 minutes. Kyle and I will chat for about 25 minutes, then we'll open it up to questions from you, the audience. We'd love to hear from you. If you do have any questions, please use the Ask a Question button which is on the right of your screen. And we hope our conversation will provoke plenty of questions from you.

One of the things I'm interested in is also getting your view on artificial intelligence and how often you use it, and that's the subject of today's poll. So the question is, when was the last time you used ChatGPT or another form of generative AI? Was it this week, this month, this year, or never? So we'll be coming back with the answers of those questions, so if you

could respond to that we'll come back to that a little bit later on.

Kyle, I wanted to start by asking you a broad question about what's driving artificial intelligence progress?

KM: The first thing I'd say is that artificial intelligence is a very broad word. It's actually come to mean quite a few different things over the last 50 or 60 years as we developed the computer and started working on it. What it means today is machine learning, and this is the idea that, rather than telling a machine or a computer exactly what to do, you rather let it learn for itself. And typically, this involves learning from data.

What I'd like to do though first is just take a step back. I really want viewers to understand that this has been coming for a very long time. When you think about, first we had the computer, then through Moore's Law we had smaller and smaller chips and computers which meant that more people could have them because they were cheaper. Now that we have loads of computers, well, that meant that we wanted to connect them together, so we had the internet. When we had the internet, suddenly we had a huge amount of digital information being produced.

This basically led to this point in 2010 where you had this Goldilocks period where we had enough compute power, we had loads of data, and therefore the machine learning paradigm which we'd actually known about for a long time suddenly became totally viable. And since 2010 to today, we've just seen more and more innovation and progress. We've seen computer vision, which was a huge thing in 2010 to 2020, and now with GPT, it's all about language, the fact that we can generate unbelievable language.

MB: Tell me more about language and the progress that we're making there.

KM: Yes. Language is a really interesting one because it also really highlights the difference between the pre- and post-machine learning paradigm. So, getting a computer to understand natural language, the ways humans speak, because the way humans speak is incredibly ambiguous and fuzzy, whereas computers, when you think about code, it's very structured.

So let's go back to I think 80s and 90s. There were a lot of really intelligent researchers trying to tell a computer how to understand language. They did this from the bottom up, by starting with grammar, vocabulary, exceptions to all these different languages. And it was just far too difficult. It was far too difficult a task to build it up from scratch.

Now, it turns out that all those researchers had to do was just wait, wait for the compute to get better and for machine learning to be viable, which is the case now. And instead of trying to start from the ground up, as I've described, it's just a case of throwing a huge amount of data, in this case with GPT, the internet, into one of these models. And it turns out that it's learnt for itself, and that's by far and away the more powerful method.

I think what's particularly interesting is, it's a bit non-intuitive in that this method of machine learning, you're kind of taking your hands off a bit. Instead of putting in all the details, you're just letting the machine learn for itself.

MB: You started off by saying it's been around for a while, but was there a trigger, in your view, that made machine learning viable?

KB: Yes. The ideas have been around 30s or 40s. They've had different names, connectionism, neural nets, which has persisted, but as I said a moment ago, I think 2010 was a real key moment. So, to go into a bit of detail, what happened

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

was a group in Canada, an academic group under Geoffrey Hinton, in essence figured out the vision problem of how to get a computer to understand what an image was and what they were looking at.

So, I've already mentioned the data. That was key. You had this huge set of data that had labels. It didn't just have a picture, it also had... was it a cat, was it a dog, was it a house, was it a bike? Just to bring this to life, I'm sure all our viewers will have done a CAPTCHA when you have to identify things in a picture to get through security. That's you labelling pictures. That's what I talk about, having data.

But it wasn't just the data. It was also the compute. So, also at this time, a new hardware kind of paradigm basically using graphical processing units... Before, it was all about CPUs, but in essence, in 2010 they figured out that GPUs were incredibly good at training these models. And since then, it's exploded.

MB: And what are the implications for us as investors from this?

KM: It's huge. I think something that we've already thought about quite a lot is, just sticking to what I was saying about GPUs, is that kind of foundational infrastructure. So, first of all, I think that this is a huge trend that's going to go a long way. I think that more and more of how we develop software will be more about training computers rather than telling them what to do.

Now, that could go a lot of different areas, and we can talk about that, but one of the things that we've been interested in for a very long time is that chip layer, because that has been essential. So, one of the companies that we've been really interested in has been NVIDIA, which is the company that is the company when it comes to GPUs.

MB: And tell me more about NVIDIA, because they're about parallel processing, aren't they?

KM: Yes. So, I probably won't go too much into the details, but the most important chips in a computer for decades and decades have been CPUs. These are very general-purpose chips. They can do a lot of things very well, but they tend to run sequentially. Now, there was another class back before 2010, quite a niche class of chips, graphical processing units, which did things more in parallel.

Now, for most of its history, this was all about gaming. You find these chips in high-performance computers, in your consoles, but what was really interesting about NVIDIA as a company is that they had the foresight to realise that it could be used for more. They didn't know exactly what, but they actually designed the chips and the software around the chips in such a way that they could be used for other purposes. They made it really easy for users to take it in whatever way they wanted.

And they were rewarded by that because, basically, the AI research community figured out that these chips, which were predominantly used for gaming, were actually perfect for AI. And because NVIDIA had made it so easy to push it into different directions, it became widely adopted. And really, that's why for the last 15 years you could say that AI and machine learning's progress and NVIDIA has been totally symbiotic.

MB: And NVIDIA is a fascinating company, the world's first trillion-dollar chipmaker. It reminds me of a lot of companies we invest in, the likes of Tesla, SML, TSMC, that have built up a competitive moat and they're also probably roughly a year or two ahead of their competitors. How hard is it for a company like that to stay ahead? And what gives it that competitive moat? How does it get there?

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

KM: Yes, it's a great question. Typically, to summarise, NVIDIA's competitive edge is often talked around the software around using the chips. Its software stack is called CUDA. And I think that's broadly true, but really it comes down to... NVIDIA have put a huge amount of effort, to repeat my point, in making it very easy for their chips to be used in lots of different ways. So when I say CUDA, really you can imagine that NVIDIA just have a lot of researchers who are writing software to make it ever easier for their end customer to experiment or try different applications.

So, they kind of have to keep doing that, but I think particularly when there's so much momentum behind [AI] and it's still incredibly important, as long as NVIDIA keep making it easy, a researcher isn't going to go somewhere else if it's easier with NVIDIA, particularly when I don't think we're still at a point where cost is the issue. It's about quality and being the best.

But of course, they're going to have to keep at it because the ecosystem isn't necessarily going to accept that they totally rely on NVIDIA for their chips.

MB: Let's go and have a look. I'm intrigued by how everyone's voted in the poll. So let's have a look at the poll results. So, just a reminder of the question. It was, when was the last time that you've used ChatGPT or another form of generative AI? Was it this week, this month, this year, or never? So the answers are, this week, quite a few, that's 34 per cent. I'm just rounding up the numbers here. This month, 21 per cent. This year, 20 per cent. And never, 25 per cent. So, quite polarised on either end, but evenly spaced.

KM: Yes, kind of actually quite flat. That doesn't surprise me. I really think that GPT has just been an incredible consumer-facing product in that AI has been this huge thing for a long time, but I really think it wasn't until there was a viable consumer product like ChatGPT that it really entered the cultural consciousness. But despite that, it's still early days. And it doesn't surprise me that some people love it, some people are finding great use cases out of it, and that that scales all the way to some people not finding any. But it's early days. I think there's still a lot of new iterations of different products to come.

MB: This is Disruption Week, so I want to ask you, in your view, which companies are being disrupted and by whom?

KM: Yes, that's a really interesting question. So, usually when I think about disruption, you look at the incumbents who may be disrupted. And I think naturally in this case you'll look at the big tech, the big platform companies. I'm thinking Google, Microsoft, Amazon, maybe Meta as well. And in this case, right now it's now clear that they'll be disrupted by this technology. In fact, there is an argument that this is a sustaining technology, and by sustaining, I mean almost the opposite of disruption. It almost maintains or enhances their competitive edge.

So, why might this be the case? I think there's three reasons. One is data. They have quite a lot of it, and I've mentioned that data is quite important. And not just that they have a lot of data, but as a bit of a softer factor, they have a lot of experience of utilising data. Two is capital. Both training and running these models is very expensive. These are huge models that require a lot of energy to run. That's quite prohibitive. That might make it difficult for some people, smaller players, to create these models.

But the last one, which I think is probably the most interesting one, is the distribution channels. I think that a lot of the AI products that we're going to see are going to look like an evolution of software. They're going to be amazing, but they're things that you could add to any software product today. And these companies already have a lot of software products,

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

they already have access to customers, and I really do feel like they're just going to be the first ones who are able to push these products down the distribution channels. And I think they're going to learn an awful lot about what works and what doesn't very early on.

For example, I'll be very intrigued to see how Microsoft's Copilot is received. That's basically coming in about now, but Microsoft be the first ones who get that information. I think that'll be another advantage. As I said to you a couple of minutes ago though, it's still so early. That's absolutely not to say that we won't see disruption, but at the minute it's not obvious that the incumbents will be disrupted.

MB: It seems quite a clever way of phrasing it the way Microsoft have termed it, Copilot, as opposed to Pilot. Is that the way that we should look at artificial intelligence, that it's a copilot as opposed to a pilot?

KM: Yes, certainly. Certainly. Look, we can talk later about what's coming far into the future, but machines and humans are different. They have different skillsets. Machines work very well with scale. Humans work very well off singular examples and learning from very little information. So I think it makes sense right now to think about how you work together. And a probably more factual thing is that AI is not really that reliable at the minute. Sometimes it hallucinates.

MB: What do you mean by hallucinates?

KM: So, hallucinating is a term used when you're speaking to GPT and it says something with great conviction that is factually wrong. At the end of the day, what GPT is doing is it is predicting the next word. That's all it does. So, if you ask it something, it reads all the words that you've said and then it predicts what it thinks the most likely next word is, and then it does it again by just adding its prediction in again and again.

At each point, this is statistical, and it can kind of drift, where it gets one slightly wrong and then it gets another slightly wrong. It can diverge. So, yes, hallucination is a thing. It still needs to be tightened up. But until we can fully trust AI, forget about the human and machine difference. It has to be a copilot because it needs to be checked upon by a human who has agency.

MB: So the data is a key point that's coming through, because that gives AI an ability to learn. The big tech companies seem to be dominating at the moment. Do you see room for an emerging challenger coming from somewhere different?

KM: Of course. Of course. I think one of the things that I'm most interested in is whether you'll get a fundamental shift in infrastructure. So, I'm thinking, for example, computing, because when you get big shifts, it's very hard for the incumbents to stay where they are. So, for example, we've been used to a graphical user interface, whether interacting with a laptop or an iPad, but who's to say that's the way forward? Now that we have GPT, we have these language models where you can converse in natural language with AI, with your computer.

Maybe most of how you actually interact will be that way. Maybe this idea of clicking and tapping things, maybe that's wrong. So, if you do get any sort of change like that, that will be such a seismic shift that of course there will be chances for new players to emerge.

MB: And could we see just a completely different form of hardware that's removed from an iPad or a watch or a computer?

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

KM: Yes, potentially. You have these maybe more sensationalist rumours in the papers of Jony Ive talking to Sam Altman from OpenAI about whether you need to reimagine what that device should look like with this new paradigm. Yes, why not?

MB: And we've talked about the primary effects, but what about some of the secondary-order effects, companies possibly in areas like healthcare and education that might see benefit from AI?

KM: Yes, I'm really excited about healthcare. And the reason why is that biology is fundamentally very complicated. The human body is a complex system, which to my mind basically means we don't understand how it works. We've got very limited theories. How we do science, building up reductively from the ground up, doesn't really work, whereas this is exactly the type of thing that machine learning and this current form of AI is amazing at. It's, give me the data, I will find patterns that you can't see, and we'll go from there.

And there are some great examples already of this. There's some of the companies that Baillie Gifford have invested in, such as Recursion Pharmaceuticals, are looking to use AI to massively reduce the cost of discovering new drugs. And this is because they want to increase the efficiency, because drug discovery is so inefficient. You have to go through a huge number of trials to get something that works, which basically means it costs a huge amount of money. This is because it relies on human intuition and theory, and it's not very good.

They've got this dream of utilising AI to turn this into a search problem, which you can do incredibly quickly and, as I said, means you're far more efficient. Anything like that, and I think there'll be lots in healthcare, it's going to be really amazing.

MB: Yes, it's fascinating. They're using huge supercomputers, conducting millions of experiments, looking at areas like oncology. The other company I wanted to chat about, and something close to home because the kids are using Duolingo quite a lot to learn things like Gaelic and German at the moment, this is another fascinating company.

KM: Yes. Again, I think education is really interesting. So, Duolingo is a great example. Fundamentally, it's about scaling education. They're focused on language at the minute, but I think they've got hopes to move beyond that. But the idea is that if you have a phone, you should have access to the ability to learn a language. You shouldn't be only restricted to [it] if you have access to a teacher, which may be limited.

But there are limitations to the methodology that they have. One of the things that these large language models allow for are virtual assistants. We've already seen this with GPT, the fact that you have a conversation, but this is what you're going to be able to have. In fact, Duolingo already have this, where instead of... when you do a translation, you get told you're wrong, you can actually have a conversation with a digital entity as to why you got it wrong, and you can talk as long as you like.

You can do scenarios, like you're actually in the country. You can actually talk to somebody for as long as you like. I think this is really amazing for Duolingo. But in general, I think it's really interesting for education because I think AI is really going to allow us to scale education, and that's just a good thing.

MB: And they kind of gamify it as well, don't they, which is genius.

KM: Yes.

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

MB: Let's have a look at some of the challenges in AI. There are a few existential threats that it poses, regulation, supply chains. Let's start with the existential threats. Do you think that this is a threat, that AI could become more powerful than humans?

KM: Yes, of course. There's a lot of very intelligent people who've thought very deeply about this, who feel this. So, I'm of the opinion that who am I to dismiss these people out of hand? And to be clear, we're talking not just Elon Musk but also Geoffrey Hinton, who I mentioned, and also Yoshua Bengio. Between Hinton and Bengio, those are two of the three godfathers of AI. So, no, I do take it seriously, and it's easy to see why they think that. Not just looking at AI in the last ten or 15 years but looking at technology over the last 100 years, it kind of feels like that might be inevitable.

Now, that being said, there are also plenty of people who struggle with the specifics of this because, what do you mean? What is consciousness? But the thing that I mainly think about is, I don't like people getting too caught up in just the existentialism. Don't dismiss it. I'm glad there are some people who are working on that. But there are other issues more mid-term that we need to think about, for example, the environmental impact of AI, biases, so understanding what these things are actually doing when we embed them into our infrastructure, and misinformation.

I think the key for me is to be balanced. We have to think about both of these. There's an annoying trend at the minute where if you believe in the existentialism, then, well, none of this other stuff matters. Let's be optimistic and let's think about both.

MB: And out of the three, it's probably the supply chain that's not talked about much. What are some of the environmental implications here?

KM: Yes. I mentioned to you that it's important to think about these models are they're huge. Think of it as the biggest Excel spreadsheet that you've ever seen. And that means they are very energy-hungry. They're brute force machines. They're really brute force. They need a lot of electricity, which produces a lot of CO₂. Not just that, but computation is just inefficient, which means that it gets hot, so you need to cool it down with water, so you're using quite a lot of water.

I think the issue a little bit is that sometimes, using GPT, it can be very abstracted away from the real-world consequences. So I think one of the most interesting trends that will be talking about more and more is about productive computation per watt. I think at the minute we're just super impressed with what GPT can do, which makes sense. We've just started. Or with any of these AIs. But we're going to quickly start discussing how impressive it is relative to the amount of energy that we use, because if something is moderate we might suddenly think that it's less great, when maybe it's more of a kind of novelty, but if it's costing us hugely environmentally, okay, this is kind of crap.

MB: And you can read more about the environmental effects with an interview with Kate Crawford from Microsoft, which is on our website at bailliegifford.com/insights. And we're coming to your questions soon, so please do ask questions. Just use the Ask a Question button which is on your screen. But before we do, I wanted to ask you about when you started at Baillie Gifford, you looked at how AI could improve the investment process. What did you discover?

KM: Yes. So, that was a six-year project that I recently stopped. What did I learn? Probably something very high-level, and then something a bit low-level. So, low-level is that, again, data is hugely important. It's all about long-term investing for us, so we're only interested in long-term forecasting, which in a nutshell means that you're actually relatively limited to the amount of data you have, which restricted the complexity of the models, which I think was a real critical factor for us.

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

But then at a higher level, I think it was brilliant because we've got a lot of institutional wisdom about how AI actually works, what the practicalities are. And I think that's given us, as I said, a really good intuition as investors looking at companies and looking at how these trends go forward, because we actually have a little bit of our own understanding. We're not just relying on what people are telling us. I think that will be really important. I think that'll help us do a much better job for our clients.

MB: And why did you stop it?

KM: Related to the data factor mainly, in that I felt like it would limit the complexity of the models relative to the challenge of long-term investing. And in a nutshell, I felt like we weren't going to be able to produce a world-class strategy, and that's really what we'd want to do. We want to be the best investors that we can be. So it's okay to stop it because even if that particular project or idea wasn't going to be amazing for our clients on its own, we've since dispersed the team, but everyone is still here. We've just been re-pollinated and there'll be new projects starting. And that's the main thing, that we're overall getting better.

MB: And did you view change during the course of that project about AI, beginning and end?

KM: No, not at all. I just still see this as a huge major trend. What it did instruct me on is the amount of sweat, effort and innovation that is required to see these changes. I think sometimes when you're looking from the outside in, it's very easy to take for granted this change, like it is just totally inevitable. But that's not quite the case, and a lot of hard work and foresight has gone into it, and I've talked about how the conditions are perfect and that this should be a long trend, but it's not guaranteed. If we don't come up with certain innovations along the way, it might plateau or fall.

MB: I think what's fascinating is [that] you've had something that's built up and then you've got this rapid kind of supersonic acceleration of artificial intelligence. As an investor, because there are so many things going on, do you find it difficult to focus on the opportunity with AI because it's so vast?

KM: I think it's still early. What I love about the opportunity of AI is that looking back at history can be so instructive. I think all the ingredients are there to understand what are the best opportunities going forward. We just need to take a breath, look at what's been, and go from there. I think it's important not to get too caught up in this moment. This moment seems chaotic, but as I said, when you take a step back, you can see where this is going. And I think that's just exciting me really.

MB: And I guess it's also trying to identify the opportunities where AI is trying to solve a problem, as opposed to AI for AI's sake.

KM: Yes. Look, there'll be some companies, and these are the ones that are getting the most attention at the minute, that are going to be building out the infrastructure for AI in the future, so OpenAI, Anthropic, who are building these big models. I've talked about NVIDIA already. There might be some other ones. But much like with software, we've gotten to the point that nearly every company is a software company. They're just solving particular problems for society using software. I think we're going to get to that point.

So, some of the companies are interesting in terms of setting up the infrastructure, but I don't get too focused on them. I'm just as interested in companies in all different areas of the economy who will use AI in interesting ways.

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

MB: And are we going to see AI software?

KM: Yes, yes. I think so.

MB: Already seeing it.

KM: Yes. This is generally this idea of it'll evolve. How we construct software will change. Again, it's this notion of instead of directly telling the computer what to do, this old school notion of hacker coding, it'll be more about training a computer what to do. And I think that software is going to be much more of a living thing that you can interact with, which I think will be really interesting.

MB: Now we're going to go to your questions.

Your questions answered

MB: So we've got plenty of questions that are coming in. Let me start with the first one here. How do you think about the potential social and geopolitical implications of recent and near-term likely AI advancements?

KM: Okay, let's split two. Geopolitical, I think the main thing that we're seeing at the minute is the tension between US and China. So, there's a couple of ways to think about this. First of all, I think China will develop their own AI. They have all the ingredients at the minute. The only thing they're missing is chips, but they will. So, that's kind of how I think about the geopolitical. Social, that's just a huge question, so I think I'm going to jump over that one because we could talk about the ethics of it all day.

MB: And we do seem to be seeing more collaboration, I guess. We had that conference recently and quite a few countries and companies were represented.

KM: I'd be very hopeful that we come together globally and actually develop this properly and not let this become an escalation.

MB: We've got a question here about one topic that we did touch on, but I guess we didn't go into depth with. How are the regulators dealing with this?

KM: The main thing that we're seeing at the moment is from the US, and what they are looking like they want is explanations from companies. How are you using AI? What advancements are you making in AI? The regulatory question is absolutely fascinating because it is not clear what the best route [is]. On the one hand, you could go heavy regulation, which promotes few companies being able to develop this, but they're heavily regulated. Maybe that's a good thing because, as I said, you can keep an eye on those actors. However, it's bad thing because there's a concentration of power.

On the other side is very little regulation and you promote transparency and open-source software, and you have a proliferation of AI. That's a scary and bad thing because you have a proliferation and you don't have a handle on what's going on. It's a good thing because there's no concentration of power.

MB: I guess there's also possibly a danger of stifling innovation if you regulate too quickly, too fast. This is a cracking

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

question. What are your thoughts on the ethics of artificial intelligence? For example, maybe as an editor - I like it because it talks about authors - there are authors whose books are being used to train AI without consent or payment of royalties. Also, you mentioned that people have agency. How do we ensure that in the future, AI does not remove human agency?

KM: Okay, great questions. Let's split that into two parts. Let's take the authorship one. Look, that's an incredibly important question. Let's take the extreme case, that we end up developing AI that is so amazing that it can do everything, do all the jobs, do all the tasks. I don't think this will happen, but let's take this example.

That will have only happened because it will have trained on society's data. That should be society's property. So we're going to have to figure out a way to compensate for that. I think you will struggle to stop training on this data, but I absolutely think that for this to work out well for society, we're going to have to figure out a way to have that compensation.

And then on the second point, remind me... agency. There's a branch of AI research called AI alignment, and this is trying to figure out how to create a safe superintelligence. And I think this comes down to this. How can you maintain human agency? Part of it's going to be that. Part of it's going to be law, our own society and rules and what we deem acceptable and what we deem not acceptable. Is it going to be acceptable for AI to incorporate a company? Maybe it can, but that doesn't mean it's going to be legal.

MB: I guess these parameters will be both regulated and unregulated in terms of how we deal with things and socialise things. Another question here. Should AI be open-sourced or closed-sourced?

KM: Going back to what I said, I'm not sure. I would say the following. I would probably say open-source. However, I do hear the argument that at a certain level of performance, maybe closed-source is better. Again, I think it's actually a spectrum. And I think you can probably think about this in terms of, I don't want to get hyperbolic, but nuclear weapons. At what point do you really think something is so powerful and dangerous that you don't just want anybody to have it? So I think there's going to be a little bit of nuance in that one.

MB: A question here about, I've seen references to the pace of development of AI outpacing Moore's Law, and this is something that Jensen talks about quite a lot in NVIDIA. Can you comment on this, and do you agree? Maybe just define Moore's Law a little bit before you get into that, if that's okay.

KM: Yes, sure. Moore's Law, this is Gordon Moore, who is one of the inventors of the transistor. It's funny, it's not really a law, it's more of a prediction that we keep making come true with our ingenuity, but it's that something roughly along the lines that the number of transistors on a chip will double every year or something like that. But in essence, what it's come to mean is that we get more computation for cheaper over time, and that's driven a huge amount of the economic value over the last 20, 30, 40 years.

Do you know what, I can't. I actually can't really comment on that. I don't know the scaling for AI. I can comment on some of the factors like GPUs being an accelerant, but I don't know how long that will run for. Growing the size of the models can be an accelerant, but again, I don't know how long they run for. So, maybe it is true, but I'm not sure whether it's quite at the faster than Moore's Law. Maybe at the minute, but will that run? I don't know.

MB: A question here. What are the main subindustries potentially most negatively impacted by AI, companies that could

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

disappear because of technology? Disappear is quite a strong word.

KM: Yes, I don't know. Let's go for a really extreme case. Look, anything today that you think is predominantly... Think about what GPT could do today. If an industry is that, then that's not very promising. But I think most industries will probably just change quite a bit. I understand the question, but I think everything will just change.

MB: Yes. I guess a different way of looking at it is it can help push us further, can't it?

KM: Yes. Look, let's take law. I truly think that you'll end up having smart contracts where you'll be able to converse with a legal contract. That will change how lawyers work, but I wouldn't be confident to say there'll be no more lawyers.

MB: And is there an innovation outside of the US, and you touched briefly on this, for example, that China is working on or in another country?

KM: Yes. You have China. A bunch of their equivalent internet companies, Tencent, Baidu, and in fact SenseTime as well, have started to release language models which aren't quite as big as the state-of-the-art US ones, but they're not far behind. What else? There's some open-source models that have also come out. But yes, I think that's probably the most interesting one at the minute, those two.

MB: Okay. And I'm going to ask a question and then I'm going to answer it myself.

KM: Okay, no problem.

MB: Great use of your time. Will you make the recording of the talk available? And the answer to that is yes, it will be made available tomorrow, and you'll be able to find that at bailliegifford.com/disruptionweek.

I want to give you the opportunity to leave the audience with one closing thought, Kyle, in no more than a minute. What would that be?

KM: I think my closing thought would be that AI and machine learning, it is understandable. This is a long trend that will be very important in everyone's lives, and I think it's important that it's not seen as being magic. I think sometimes the communication around AI isn't great. So, hopefully this talk inspires everyone to learn a little bit more. And I really think that can be understood at a very high level by quite a lot of people, and we should all try to get to that point.

MB: I've loved chatting to you about the future of AI and what's being disrupted and by whom. I hope you, the audience, have enjoyed it as much as we have. And if you do have any questions, please get in touch with your client contact or email us at disruptionweek@bailliegifford.com.

And in tomorrow's Disruption Week we'll be talking about nuclear innovation. We'll be chatting to Luke Ward, an investment manager here, about one company that is researching treatment for cancer, and also finding ways of recycling atomic waste. We hope you'll join us. In the meantime, thanks for investing your time in Disruption Week.

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.

Risk Factors

The views expressed should not be considered as advice or a recommendation to buy, sell or hold a particular investment. They reflect 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 November 2023 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.

This communication 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 communication 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.

Financial Intermediaries

This communication is suitable for use of financial intermediaries. Financial intermediaries are solely responsible for any further distribution and Baillie Gifford takes no responsibility for the reliance on this document by any other person who did not receive this document directly from Baillie Gifford.

Europe

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. Baillie Gifford Investment Management (Europe) Limited is authorised by the Central Bank of Ireland as an AIFM under the AIFM Regulations and as a UCITS management company under the UCITS Regulation. Baillie Gifford Investment Management (Europe) Limited is also authorised in accordance with Regulation 7 of the AIFM Regulations, to provide management of portfolios of investments, including Individual Portfolio Management ('IPM') and Non-Core Services. Baillie Gifford Investment

Baillie Gifford™

Management (Europe) Limited has been appointed as UCITS management company to the following UCITS umbrella company; Baillie Gifford Worldwide Funds plc. Through passporting 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. Similarly, it has established Baillie Gifford Investment Management (Europe) Limited (Amsterdam Branch) to market its investment management and advisory services and distribute Baillie Gifford Worldwide Funds plc in The Netherlands. 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"). The representative office is authorised by the Swiss Financial Market Supervisory Authority (FINMA). The representative office does not constitute a branch and therefore does not have authority to commit Baillie Gifford Investment Management (Europe) Limited. Baillie Gifford Investment Management (Europe) Limited is a wholly owned subsidiary of Baillie Gifford Overseas Limited, which is wholly owned by Baillie Gifford & Co. Baillie Gifford Overseas Limited and Baillie Gifford & Co are authorised and regulated in the UK by the Financial Conduct Authority.

China

Baillie Gifford Investment Management (Shanghai) Limited 柏基投资管理(上海)有限公司 ('BGIMS') is wholly owned by Baillie Gifford Overseas Limited and may provide investment research to the Baillie Gifford Group pursuant to applicable laws. BGIMS is incorporated in Shanghai in the People's Republic of China ('PRC') as a wholly foreign-owned limited liability company with a unified social credit code of 91310000MA1FL6KQ30. BGIMS is a registered Private Fund Manager with the Asset Management Association of China ('AMAC') and manages private security investment fund in the PRC, with a registration code of P1071226.

Baillie Gifford Overseas Investment Fund Management (Shanghai) Limited 柏基海外投资基金管理(上海)有限公司 ('BGQS') is a wholly owned subsidiary of BGIMS incorporated in Shanghai as a limited liability company with its unified social credit code of 91310000MA1FL7JFXQ. BGQS is a registered Private Fund Manager with AMAC with a registration code of P1071708. BGQS has been approved by Shanghai Municipal Financial Regulatory Bureau for the Qualified Domestic Limited Partners (QDLP) Pilot Program, under which it may raise funds from PRC investors for making overseas investments.

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 and a Type 2 license 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 Suites 2713-2715, Two International Finance Centre, 8 Finance 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.

Baillie Gifford™

Australia

Baillie Gifford Overseas Limited (ARBN 118 567 178) is registered as a foreign company under the Corporations Act 2001 (Cth) and holds Foreign Australian Financial Services Licence No 528911. This material is provided to you on the basis that you are a “wholesale client” within the meaning of section 761G of the Corporations Act 2001 (Cth) (“Corporations Act”). Please advise Baillie Gifford Overseas Limited immediately if you are not a wholesale client. In no circumstances may this material be made available to a “retail client” within the meaning of section 761G of the Corporations Act.

This material contains general information only. It does not take into account any person’s objectives, financial situation or needs.

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 (‘OSC’). 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 International LLC is regulated by the OSC as an exempt market and its 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.

Israel

Baillie Gifford Overseas Limited 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 material is only intended for those categories of Israeli residents who are qualified clients listed on the First Addendum to the Advice Law.

Baillie Gifford™

Calton Square, 1 Greenside Row, Edinburgh EH1 3AN
Telephone +44 (0)131 275 2000 / bailliegifford.com

Copyright © Baillie Gifford & Co 2023.