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Artificial Intelligence and Law: Emerging Divergent National Regulatory Approaches in a Changing Landscape of Fast-evolving AI Technologies

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Artificial Intelligence and Law: Emerging Divergent National Regulatory Approaches in a Changing Landscape of Fast-evolving AI Technologies

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Lijun Zhao *

Abstract

As AI encompasses a broad range of technologies and is evolving rapidly, this contribution argues that policy-makers at both national and global levels are facing the "pacing problem" – technology is developing faster than the policy-makers' ability to keep up. While AI largely is unregulated across WTO members on a global scale, a handful of AI powers – the US, EU UK and China – have started to regulate AI to secure the first-mover advantage. This contribution finds that the AI powers have developed divergent regulatory responses to handle the pacing problem at the national level. At the international level, the pacing problem also exists; this contribution examines the deficiency of global trade law governing areas of trade in goods, services and trade-related intellectual property rights.

Keywords: Artificial Intelligence; Regulatory Frameworks; Divergency; Pacing Problem; the Global Trading System

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I. Introduction

Back in the mid-1950s, some pioneers of Artificial intelligence (AI) set themselves an impossibly lofty but well-defined mission: to recreate human intelligence in machines. In 1955, in Dartmouth, USA, John McCarthy and his talented collaborators coined the term "Artificial intelligence", a branch of computer science with this mission.[1] In the early days of AI research, Alan Turing, who is usually considered the father of modern intelligent machines, proposed that the true indication of computer intelligence is when a question-asker could not distinguish between answers from humans and from computers.[2] Today, AI is no longer a mere imagination in science fiction. In fact, AI is a reality. From using a virtual personal assistant to schedule our workdays, to language translation, to our mobile phones recommending video clips, news, music or restaurants that we might like, to travelling in self-driving vehicles, AI has become a part of our lives.

While AI science has made steady but slow progress, only recently has it accelerated rapidly, which enabled academic achievements to be transformed into real-world use cases. So many AI experts point out that AI is having a renaissance, and we have embarked on the era of AI.[3] Sixty years after its origin, AI has transformed into an enabling technology with the power to reshape every aspect of the real world in which we live.[4] Nowadays, AI is characterised by a number of applications, including computers that play games with/against humans, understanding human languages, virtual personal assistants, computer vision, and robotics that involve computer vision, hearing and responding to sensory stimuli.[5]

Much of the recent unprecedented progress in AI has been largely driven by a combination of three factors – the dramatic technological advances in computing power and capacity, availability of massive amounts of data, and progress in algorithms.[6] With the help of all these three factors collectively, AI applications, such as deep learning, marked the most significant leap forward in the past sixty years; the leap on this scale rarely comes more than once every a few decades.

This contribution argues that, as AI encompasses a broad range of technologies and is evolving rapidly, this contribution argues that policy-makers at both national and global levels

[1] John McCarthy and others, 'A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence' (1955). p 11

[2] Alan Turing, 'Computing Machinery and Intelligence' (1950) 59 Mind 433.

[3] Kai-Fu Lee and Yonggang Wang, *Artificial Intelligence* (1st edn, Cultural Development Press 2017).

[4] See details in Artificial Intelligence (AI) worldwide - Statistics & Facts, https://www.statista.com/topics/3104/artificial-intelligence-ai-worldwide/#topicHeader__wrapper, Statista, 2021.

[5] Rahul Pareek, 'Web Intelligence-An Emerging Vertical of Artificial Intelligence', International Journal of Engineering and Computer Science (2012), 9430-9436.

[6] International Telecommunication Union (ITU), Assessing the Economic Capacity of Artificial Intelligence (2018), pp1-2. Lee and Wang (n 3). Stating Deep learning + Large Data = the Renaissance of AI.

are facing the "pacing problem" – technology is developing faster than the policy-makers' ability to keep up.[7] Moreover, while AI largely is unregulated across WTO members on a global scale, a handful of AI powers – the US, EU, UK and China – have started to regulate AI to secure the first-mover advantage. This contribution argues that several AI powers have developed divergent regulatory responses to handle the pacing problem at the national level. Subsequently, this contribution argues that the pacing problem also exists at the international level, by examining the deficiency of global trade law governing the areas of trade in goods, services and trade-related intellectual property rights.

II. Benefits and Costs Associated with the Development and Deployment of AI

A. Opportunities

AI is critical to global trade law and governance in the fast-changing landscape. Just as one coin has two sides, AI is changing the world, bringing opportunities and challenges to international organisations, governments and civil society.[8] AI expert Kai-Fu Lee predicts the impact of AI will be "more than anything in the history of mankind."[9] Other sources, such as McKinsey, also foresee that AI will trigger advances that transform lives, business and the global economy.[10]

Many sources forecast the enormous benefits that AI will bring about. According to McKinsey, AI has enormous potential to contribute to global economic activity, and it could generate additional global economic activities worth approximately $13 trillion by 2030.[11] Another source suggests that, by 2025, the automation of knowledge work, robotics and self-driving vehicles will generate 6.5-12 trillion Euros per year (including improved productivity and higher quality of life in ageing populations).[12]

Still, the full potential of AI has yet to be fully realised, waiting to be unleashed in the coming decades and even centuries. Technologists offer a wide range of predictions about upcoming AI developments, from AI being used as a tool to aid relatively simple processes (through

[7] Braden R. Allenby (auth.), *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem* (Gary E Marchant, Braden R Allenby and Joseph R Herkert (eds.) eds, 1st edn, Springer 2010). (coining the term 'pacing problem'). Lyria Bennett Moses, and Monika Zalnieriute, Law and Technology in the Dimension of Time, in Sofia Ranchordas and Yaniv Roznai (eds), *Time, Law and Change: An Interdisciplinary Study* (Hart, 2020), 10.5040/9781509930968.ch-014, 303-326.

[8] Deloitte, Areas of preparedness and concern among AI adopters worldwide as of 2020, Statista, July 2020, https://www.statista.com/statistics/1136694/artificial-intelligence-concern-preparedness-2020/.

[9] Lee and Wang (n 3).

[10] McKinsey Global Institute, Disruptive technologies: Advances that will transform life, business, and the global economy, 2013.

[11] Jacques Bughin and others, 'Notes from the AI Frontier: Modeling the Impact of AI on the World Economy' (*McKinsey Global Institute Discussion Paper*, 2018) <https://perma.cc/6ZFR-2LRT> accessed 31 December 2021.

[12] Accenture, Why AI is the future of growth, 2016.

weak AI technologies) to robots with human-like mental capabilities (through general AI technologies).[13] As explained later in Section III, AI can be divided into two kinds: weak and general AI. In a specific field, weak AI systems have already done better jobs than humans, as outlined at the outset. An example of weak AI beating human performance is the 2017 AlphaGo and Ke Le match.

B. Challenges

On the other hand, due to the scale and complexity of AI technologies, AI has and will address(ed) unprecedented challenges to global trade governance and policy-makers. Firstly, AI encompasses a wide range of different technologies, as illustrated above. Also, AI has become a commonplace feature in many products and services, and the division line between products and services is blurring. Given AI's ability to act autonomously and its wide range, AI systems cannot easily be classified as goods or services. This contritions finds that, at an international level, the 'goods vs services' dichotomy inherited under the global trade law for decades is no longer suitable. This issue will be explained in detail later in Section IV.

Similar to the above issue, another key challenge is the pacing problem due to a mismatch between legal and technological developments. One example is the dichotomy that global trade law draws on between goods and services. Another example is that it is unclear to what extent AI-driven products are subject to product liability law.[14] Much literature has discussed the interplay between AI and product liability law, and whether AI products should be granted personhood or not;[15] so, this contribution links its analysis with the existing literature but omits the details to avoid repetition.[16]

Furthermore, one of the most critical unprecedented challenges is that, globally, AI will widen gaps among countries, companies and workers.[17] For instance, while AI will generate economic interests and boost international trade as mentioned above, beneficiaries will primarily be a handful of developed countries, where AI will significantly enhance their annual economic growth rate by 2035.[18] Even though the adoption of AI technologies has been

[13] Peter Diamandis, "The World in 2025: 8 Predictions for the Next 10 Years." Singularity Hub, 11 May 2015. Weak and general AI will be explained later in Section III.

[14] See more in Carpenter Wellington PLLC, 'The Legal Landscape of Artificial Intelligence (AI) Law' [2022] Lexology <https://www.lexology.com/library/detail.aspx?g=d95bfa51-db03-47e0-8c63-d7c7311d84f1>.

[15] Ibid.

[16] Carpenter Wellington PLLC (n 14). So far, the EU has revised its regulation on product liability directive 1985 to cover AI applciations. Tiago Sérgio Cabral, 'Liability and Artificial Intelligence in the EU: Assessing the Adequacy of the Current Product Liability Directive' (2020) 27 Maastricht Journal of European and Comparative Law 615. In the USA, the application of product liability law in the AI context has been addressed by case law, e.g. *Cruz v. Raymond Talmadge d/b/a Calvary Coach* (2017) https://casetext.com/case/cruz-v-talmadge

[17] Bughin and others (n 11).

[18] Artificial Intelligence (AI) worldwide - Statistics & Facts, https://www.statista.com/topics/3104/artificial-intelligence-ai-worldwide/#topicHeader__wrapper, Statista, 2021.

gradually diffused around the globe through – online and offline – transnational business activities, the AI technologies are primarily dominated by a handful of leading tech giants, mainly in the developed countries such as the US, UK and some European countries (except two emerging economies – China and South Korean).[19] As illustrated in Section III, this contribution finds that those powerful countries have begun to regulate AI technologies to secure their first-mover advantages and "export" their national/regional rules as global standards for other countries in the world:[20]

At a macro level, from a country's perspective, AI is reshaping the landscape of superpowers in the AI arena and has created emerging superpowers that are clusters of non-Western and non-traditional developed countries. As per a worldwide survey on AI performance as of 2018, while the US shows the best performance in regards to AI, followed by Germany and the UK, there are two emerging economies (namely, China and South Korea) rank among the top ten countries in terms of their overall AI performance benchmarks.[21] AI specialist Lee points out that the AI revolution consists of four arenas: 'Business AI' remains the *only* arena in which the US maintains clear leadership globally; China is in a strong position to (co)lead in 'Internet AI' and 'Perception AI', and will likely catch up with the US in 'Autonomous AI'.[22]

At a micro level, from a company's perspective, those start-ups are now scrapping for a slice of an AI landscape increasingly dominated by a handful of major players. Besides IBM (the globally largest AI patent owner),[23] there are the so-called "Seven Giants of the AI age", including Google, Facebook, Amazon, Microsoft, Baidu, Alibaba and Tencent.[24] These corporate juggernauts are "almost evenly split between the United States and China", and they are making bold plays to dominate the AI economy.[25]

Given the factors above, Sections III and IV of this contribution find that policy-markers from a handful of countries have used different national regulatory responses to address AI-associated opportunities and challenges in the AI age. The remainder of this contribution, in Section V, highlights the rise of a phenomenon and emerging challenges facing global trade law and governance.

C. Emerging Divergent Regulatory Approaches in a Few AI Leading Countries

AI will (re)shape countries and market-players' global competitiveness and productivity in the coming decades/centuries, empowering early adopters of significant societal, economic, and

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[19] Artificial intelligence (AI) performance benchmark by country as of 2018, https://www.statista.com/statistics/942041/ai-performance-benchmark-by-country/, Statista, July 2018

[20] See more in Section IV.

[21] Ibid.

[22] Kai-Fu Lee, *AI Superpowers: China, Silicon Valley, and the New World Order* (1st edn, Houghton Mifflin Harcourt 2018). pp110-111.

[23] Artificial Intelligence (AI) worldwide - Statistics & Facts, https://www.statista.com/topics/3104/artificial-intelligence-ai-worldwide/#topicHeader__wrapper, Statista, 2021.

[24] Lee (n 22). pp110-111.

[25] ibid. p89

strategic advantages. As the pace of AI innovation and development accelerates – underpinned by advances in big data and high-performance computing — both the US and China are dominating, and both countries have adopted hard and soft laws to regulate AI.[26] Apart from the AI superpowers, other AI leading countries, notably the EU, have joined the race and added further regulatory complexity to the global trade governance. In recent years, European policy-makers have recognised the importance of not falling behind on AI and have sought to raise their ambitions by launching EU's AI regulations. The remainder of this contribution discusses the regulatory responses of the US, China, EU and UK, respectively, to the fast-evolving AI technologies.

III. Definition of Artificial Intelligence: Particularity of AI

Unlike the previous six decades since its origin of AI, the most remarkable feature of the current AI renaissance is that the applications of AI – in speech recognition, machine vision, data mining and other fields – have entered the real application scenarios of the industry and are closely linked to business models. Together, they are starting to show real value in the industry. For instance, in addition to playing Go, the availability of deep learning-based programs and massive amounts of data have enabled AI to do a better than human counterparts in many areas, such as identifying faces, recognising speech, and issuing loans; these are just what weak AI can do already, let alone general AI.[27]

Due to the significant scale and complexity of AI technology as outlined above, the overarching question for policy-makers and researchers is what AI is, i.e. the definition of AI. The answer to this question is vital for the law-making process at both national and international levels, as it usually affects whether a particular AI technology falls within the scope of application of a specific law, regardless of soft or hard law.

AI technologies today can be divided into five broad categories in terms of the areas of applications, according to McKinsey and many other sources: computer vision, data mining, machine learning, natural language, and robotic process automation.[28] Thus, there is a wide range of AI technologies, and more importantly, these technologies are fast-evolving with great potential to be unlashed as pointed out above. Thus, this attribute and particularity of the current AI renaissance address a question for all policy-makers at national and international levels: any static definitions will lead to the pacing problem,[29] immediately or in the short run. Namely, it is likely that AI-related legislation or regulations quickly fall behind technological development. In order to resolve the pacing problem, this contribution finds that in the US, EU and China, AI is widely defined, as discussed below.

[26] See Section IV.
[27] Lee and Wang (n 3). Lee (n 22).
[28] Bughin and others (n 11). see also EqualOcean, Share of AI technology applications by technology, Statista, 2020, https://www.statista.com/study/102790/artificial-intelligence-in-china/.
[29] Braden R. Allenby (auth.) (n 7).

A. Dictionary Definition

What is AI? That is a question. As WTO adjudicators have pointed out, in order to determine the ordinary meaning of a term, "a Panel [or tribunal] may start with the dictionary definitions of the terms to be interpreted".[30] So, it is meaningful to refer to the dictionary definition of AI. According to the Oxford Dictionary, "artificial" means something "made or produced by human beings rather than occurring naturally", and "intelligence" means "the ability to acquire and apply knowledge and skills".[31] Put the two words together, "artificial intelligence" refers to the "theory and development of computer systems able to perform tasks *normally* requiring human intelligence, *such as* visual perception, speech recognition, decision-making, and translation between languages."[32]

As seen in these three dictionary definitions, it is clear that AI must be a man-made system which has the ability to acquire and apply knowledge and skills; however, the words "normally" and "such as" in the dictionary definitions fail to clarify to what extent or level the ability is. Moreover, technology usually develops over time, so the openness in the above dictionary definitions may make a computer system that outperforms its human counterparts be an AI for some time but not an AI after technology advances later. For instance, in a 1997 match dubbed "The Brain's Last Stand", IBM's Deep Blue defeated the world chess champion, Garry Kasparov.[33] Deep Blue's victory was considered a milestone in the history of AI, since it was the very first machine to beat a reigning world chess champion; many people at that time thought Deep Blue was AI; however, by the time of the 2017 AlphaGo and Ke Jie match, most people were already used to playing computer games programmed like Deep Blue, so few people would consider Deep Blue-like systems as AI. Therefore, due to the openness and elasticity in the dictionary definitions of AI, this contribution seeks to address the overarching question by defining the concept of AI to lay down a common ground for the discussion for academics and policy-makers across countries.

B. Definitions Featured by the AI Pioneers

Among those pioneers who laid down the cornerstone of today's AI were Alan Turing, a British mathematician, and John McCarthy, an American computer scientist. Turing poses the famous 'Imitation Game' (also known as the "Turing Test"), which is still being used today by computer scientists and many companies. In 1950, Turing published a ground-breaking work entitled "*Computing Machinery and Intelligence*", in which he addressed the question of "Can

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[30] See, e.g., Appellate Body Report, *United States—Measures Affecting the Cross-Border Supply of Gambling and Betting Services* [hereinafter *AB Report, US—Gambling*], WT/DS285/AB/R (20 April 2005), Paragraph 164.

[31] Artificial, Oxford Living Dictionary, https://www.lexico.com/definition/artificial. Intelligence, Oxford Living Dictionary, https://www.lexico.com/definition/intelligence

[32] Artificial Intelligence, Oxford Living Dictionary, https://www.lexico.com/definition/artificial_intelligence. The italics is emphasis added by the current author.

[33] It is a chess-playing expert system run on a particular purpose-built IBM supercomputer.

machines think?". To answer this question, he further posed the Turing Test, which assesses whether a machine can generate human-like responses so that its behaviour cannot be distinguished from that of a human.[34] The Turing Test fills in the gap in the dictionary definition and elucidates the extent to which the "ability" in a man-made machine can be "intelligence"; nevertheless, it should be noted that the Turing Test tactfully avoids the conundrum of what "intelligence" is. Furthermore, even though some existing AI systems have outperformed their human counterparts, it is still arguably difficult to pass the Turing Test.[35]

Turning to John McCarthy and his collaborators who coined the term "artificial intelligence", which first appeared in 1955 in their paper entitled "*A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence*" by a group of leading researchers, including John Nash, a Nobel Prize winner, with combined expertise from a broad spectrum of mathematics, computer science, neurology and so on.[36] Unfortunately, McCarthy and his collaborators did not offer a solid definition in that paper. Nevertheless, these pioneers laid down the cornerstone of AI technologies, as mentioned at the outset, by setting themselves an impossibly lofty but well-defined mission to an impossibly lofty but well-defined mission: creating intelligent machines that work and react like humans.[37]

In 2007, McCarthy loosely defined AI as "the science and engineering of making intelligent machines, especially intelligent computer programs."[38] However, when it comes to the fundamental question "what intelligence is?", he explained that intelligence is the "computational part of the ability to achieve goals in the world. [There exist] varying kinds and degrees of intelligence occur in … machines."[39] Even so, McCarthy admitted that there had not been a solid definition of "intelligence" that does not depend on relating it to "human intelligence" yet, since "we cannot yet characterise in general what kinds of computational procedures we want to call intelligent".[40] Simply put, the point McCarthy made can be illustrated by the fact that, as AI technology develops over time, many people changed their answers to the same question mentioned above – whether Deep Blue, AlphaGo or other men-made machines are AI or not.

C. Modern Approach to Defining AI

Even though there is no single definition of AI that practitioners universally accept in recent years, as McCarthy points out, a modern approach has emerged to define the term AI by referring to its multi-faceted characteristics. Russel, one of the leading AI researchers, has

[34] Turing (n 2). P442.
[35] Aleksandar Todoroviæ, Has The Turing Test Been Passed?, <http://isturingtestpassed.github.io/>
[36] John McCarthy and others (n 1).
[37] ibid.
[38] John McCarthy, 'What Is Artificial Intelligence?' (2007) 73 American Scientist 258 <http://jmc.stanford.edu/articles/whatisai.html>. pp1-2.
[39] ibid. pp1-2.
[40] ibid. pp1-2.

teamed up with Norvig, who led research work at Google (one of the seven AI tech giants), to publish a leading AI textbook.[41] This book defines AI through the modern approach that US policy-makers have incorporated into US legislation by US policy-makers,[42] so here this contribution looks at the definition of AI in this leading textbook.

Russel and Norvig summarise the existing efforts in defining AI and then define the term through using four taxonomies to accommodate the *multi-faceted* characteristics of AI as follows:

- Acting humanly (i.e. the Turing Test approach),
- Thinking humanly (i.e. the cognitive modelling approach),
- Thinking rationally (i.e. the 'laws of thoughts' approach), and
- Acting rationally (i.e. the 'rational agent' approach).[43]

Before proceeding further in this contribution, two interim findings need to be shared with readers as the stepping stones for further discussion. Firstly, AI is a rapidly-evolving family of technologies and a "truly universal" field.[44] This can be seen from the existence of a wide range of AI applications in real-world scenarios, as discussed above. Due to the scale and complexity of AI, a solid, static definition of AI in soft and/or hard law will quickly become obsolete; if such a definition were included in a piece of legislation, the legislation would have become obsolete due to the 'pacing problem' in law-making and policy-making in the field of AI.[45] Secondly, this modern approach to defining AI has generated an impact beyond academia and has influenced the law-making of the US – an AI superpower – in drafting its new bills, as discussed below.

IV. Statutory Definitions of AI: Emerging Divergent Domestic Regulatory Responses

Since 2017, at least 60 countries have adopted some forms of AI policy, with a torrent of activities seeking to promote and match the pace of AI-technology development with the pace at which policy-makers update rules.[46] However, the expansion of AI governance has raised concerns about looming challenges to international cooperation. The growing ubiquity of AI in the online services and physical devices of our daily lives means that any new regulations will significantly impact global trade governance. Thus, this section identifies and reviews the statutory definitions of AI, with a tendency of divergent national regulatory approaches, in a

[41] Stuart Russell and Russel Norvig, *Artificial Intelligence: A Modern Approach* (4th edn, Pearsons 2020). pp.19-23
[42] See the next section.
[43] Russell and Norvig (n 41).
[44] ibid.
[45] Braden R. Allenby (auth.) (n 7). See more details in Sections IV and V.
[46] OECD.AI, 'National AI Policies & Strategies' <https://oecd.ai/en/dashboards> accessed 1 May 2022. (This online database provides a live repository of over 700 AI policy initiatives from 60 countries, territories and the EU).

handful of AI leading countries – the US and China (the two AI superpowers), the EU and the UK.

A. From a US Perspective: A proactive and future-proofing approach

The US is not only an AI superpower but also a pioneer in regulating AI globally. Through following Russel and Norvig's modern approach as its statutory definitions, the US has adopted and incorporated the modern approach and its well-defined taxonomies with a forward-facing nature to accommodate the rapidly evolving nature and a broad spectrum of AI applications. By adopting the modern approach to defining AI, the US law defines AI broadly: first in the 2016 White House report on AI,[47] and later in the bill for "the FUTURE of Artificial Intelligence Act of 2017".[48]

The FUTURE bill governs not only any "artificial systems that perform tasks under varying and unpredictable circumstances, without significant human oversight" but also a set of "techniques, including machine learning to approximate some cognitive task."[49] Moreover, in order to widen the scope of application, the bill defines AI in a highly broad manner.

Section 3(a) of the FUTURE bill stipulates that

> In General. — Except as provided in subsection (b), in this Act:
>
> (1) ARTIFICIAL INTELLIGENCE. —The term "artificial intelligence" includes the following:
>
> (A) Any artificial systems that perform tasks under varying and unpredictable circumstances, without significant human oversight, or that can learn from their experience and improve their performance. Such systems may be developed in computer software, physical hardware, or *other contexts not yet contemplated*.[50] They may solve tasks requiring human-like perception, cognition, planning, learning, Communication, or physical action. In general, the more human-like the system within the context of its tasks, the more it can be said to use artificial intelligence.
>
> (B) Systems that think like humans, such as cognitive architectures and neural networks.
>
> (C) Systems that act like humans, such as systems that can pass the *Turing*

[47] White House, Preparing for the Future of Artificial Intelligence 6–7 (2016), https://obamawhitehouse.archives.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf

[48] FUTURE of Artificial Intelligence Act of 2017, H.R. 4625, 115th Congress, (2017) https://www.congress.gov/bill/115th-congress/house-bill/4625/text#:~:text=Introduced%20in%20House%20(12%2F12%2F2017)&text=To%20require%20the%20Secretary%20of,Intelligence%2C%20and%20for%20other%20purposes.

[49] US bill for the FUTURE of Artificial Intelligence Act of 2017, H.R. 4625, 115th Congress, Section 3(a)(1)(A), (D)(2017).

[50] Emphasis added by the current author.

test or other comparable test[51] via natural language processing, knowledge representation, automated reasoning, and learning.

(D) A set of techniques, including machine learning, that seek to approximate some cognitive task.

(E) Systems that act rationally, such as intelligent software agents and embodied robots that achieve goals via perception, planning, reasoning, learning, communicating, decision making, and acting.

(2) ARTIFICIAL GENERAL INTELLIGENCE. — The term "artificial general intelligence" means a notional *future* artificial intelligence system that exhibits apparently intelligent behavior at least as advanced as a person *across the range of*[52] cognitive, emotional, and social behaviors.

(3) NARROW ARTIFICIAL INTELLIGENCE. — The term "narrow artificial intelligence" means an artificial intelligence system that addresses *specific*[53] application areas such as playing strategic games, language translation, self-driving vehicles, and image recognition.

As seen from the breakthrough definitions of AI cited above, the US approach in the FUTURE bill has shown great flexibility in dealing with the pacing problem, through incorporating not only the academic definitions (e.g. "think like humans" and "act like humans')[54] but also definitions advanced by AI experts and practitioners in the industry (such as Turing test, "general AI" and "narrow AI").[55]

Moreover, the statutory definitions in the FUTURE bill have become part of effective legislation. The John S. McCain National Defense Authorization Act of 2018, which became law on 13 August 2018, followed the approach of the FUTURE bill to define AI. In the 2018 Act, AI is widely defined again, as follows:[56]

(1) Any artificial system that performs tasks under varying and unpredictable circumstances *without significant human oversight,* or that can learn from experience and improve performance when exposed to *data* sets.[57]

[51] Emphasis added by the current author.
[52] Emphasis added by the current author.
[53] Emphasis added by the current author.
[54] Turing (n 2). Russell and Norvig (n 41).
[55] Lee and Wang (n 3).
[56] the John S. McCain National Defense Authorization Act for Fiscal Year 2019, Pub. L. No. 115-232, 132 Stat. 1636, 1695 (13 August 2018) (codified at 10 U.S.C. § 2358, note). See full text of the Act https://www.congress.gov/bill/115th-congress/house-bill/5515/text
[57] emphasis added by the current author.

(2) An artificial system developed in computer *software, physical hardware, or another context* that solves tasks requiring human-like perception, cognition, planning, learning, Communication, or physical action.

(3) An artificial system designed to *think or act like* a human, including cognitive architectures and neural networks.

(4) A set of *techniques*, including machine learning, that is designed to approximate a cognitive task.

(5) An artificial system designed to *act rationally*, including an intelligent *software* agent or embodied *robot* that achieves goals using perception, planning, reasoning, learning, communicating, decision-making, and acting."[58]

It is also observed that the US is developing and expanding its statutory definition of AI to some extent. More recently, the bill for the Algorithmic Accountability Act of 2019 has not defined the term AI at all. Instead, this 2019 bill resorts to a more generic term – "automated decision system" under its Section 2(1) – which broadly embraces "a *computational process*, including one derived from *machine learning, statistics, or other data processing or artificial intelligence techniques*, facilitates human decision making, that impacts consumers."[59] As seen above, therefore, the US legislative approach nicely avoids the pacing problem and makes the US national legislation forward-facing and future-proof to counteract AI-associated challenges due to the fast-evolving nature of AI technology.

Aiming at "maintaining American Leadership in Artificial Intelligence",[60] in 2020, the White House issued a memorandum "the Guidance for Regulation of Artificial Intelligence Applications" which guides federal agencies when they develop regulatory approaches to AI.[61] While the guidance is not hard law, it sets out a series of policy considerations for the US policy-makers that should guide, to the extent permitted by law, regulatory and non-regulatory approaches to governing AI applications:

(a) Consider new regulations only after carefully assessing whether existing or evolving regulatory frameworks are sufficient;

(b) avoid hampering AI innovation and growth;

[58] Section 238(g) of the John S. McCain National Defense Authorization Act.
[59] H.R.2231 - Algorithmic Accountability Act of 2019, 116th Congress (2019-2020), https://www.congress.gov/bill/116th-congress/house-bill/2231.
[60] White House, Exec. Order No. 13,859 of Feb. 11, 2019, Maintaining American Leadership in Artificial Intelligence, 84 Fed. Reg.3967 (14 February 2019), https://www.whitehouse.gov/presidential-actions/executive-order-maintainingamerican-leadership-artificial-intelligence/
[61] The White House, Guidance for Regulation of Artificial Intelligence Applications (11 November 2020) https://www.whitehouse.gov/wp-content/uploads/2020/11/M-21-06.pdf

(c) contribute to the public trust in AI by promoting reliable robots, and *trustworthy AI* applications that do not pose risks to fundamental human rights and freedoms;
(d) embed public participation, disclosure, and transparency in rule-making processes;
(e) apply *risk assessment and risk management frameworks* and be transparent about the evaluation of risks;
(f) carefully consider the full *societal benefits and costs* associated with the development and deployment of AI;
(g) take *flexible* approaches that are *technology-neutral* and do not harm innovation;[62]
(h) consider issues of fairness and non-discrimination in regard to outcomes and decisions produced by AI applications;
(i) promote the development of AI systems that are safe, secure, and operate as intended;
(j) consider any national security implications raised by AI applications; and
(k) coordinate with other agencies to ensure the consistency and predictability of AI policies.[63]

Moreover, the White House Guidance introduces recommendations for non-regulatory approaches to AI. For instance, sector-specific policy guidance, and voluntary consensus standards.[64] The 2020 Guidance also exemplifies a list of actions that federal agencies can take to reduce barriers to the deployment and use of AI (from facilitating access, to federal data, to engaging with the private sector in the development of standards). [65]
Most recently, since Biden started his administration in 2020, a range of further regulatory changes have signalled a more proactive stance by the US federal government towards AI regulation. The US bill for the National Artificial Intelligence Initiative Act of 2020 acknowledges the importance of Artificial intelligence as "a tool that has the *potential* to change and possibly transform *every* sector of the United States economy and society."[66] Furthermore, in this Act, AI is loosely defined as below. Section 3(3) of this Act stipulates that:

ARTIFICIAL INTELLIGENCE.—The term "artificial intelligence" means a *machine-based system* that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing *real or virtual* environments. Artificial intelligence systems use machine and human-based inputs to —
(A) perceive real and virtual environments;

[62] Emphasis added by the current author.
[63] White House (n60).
[64] Ibid.
[65] Ibid.
[66] US National Artificial Intelligence Initiative Act of 2020, H.R.6216, 16th Congress (2019-2020) <https://www.congress.gov/bill/116th-congress/house-bill/6216/text>.

(B) abstract such perceptions into models through analysis in an *automated* manner; and

(C) use model inference to formulate options for information or action.[67]

It should be noted that this Act embraces both existing AI technologies (e.g. weak AI) and those that have not yet arrived (at least far from being mature, e.g. general AI). In order to understand the difference between weak AI and general AI (also called strong AI), it is meaningful to refer to AI expert Kai-fu Lee who divides the ongoing AI revolution into four waves, briefly mentioned above.[68] In detail, Lee claims that the complete AI revolution will take some time and will ultimately wash over us in a series of "four waves — Internet AI, Business AI, Perception AI, and Autonomous AI".[69] The first two waves are already all around us, reshaping our digital and financial worlds. Although acting in ways we can barely recognise, they are tightening internet companies' grip on our attention, replacing paralegals, journalists, personal assistants with algorithms, trading stocks, and diagnosing illnesses. Furthermore, Lee points out that Perception AI is still ongoing, with more AI potential to be unlashed and developed in the future, which will digitise our physical world. For instance, Metaverse. This wave of Perception AI is ongoing with the potential to blur the lines between the digital and physical worlds (This has been referred to in several places among the aforementioned US legislation and soft law), revolutionising how human beings experience and interact with our world. Ultimately, Autonomous AI will arrive, but it will have the most profound impact on our lives. For example, fully autonomous vehicles and intelligent robots might take over factories, transforming everything from organic farming to highway driving and fast food. As discussed in the above US legislation, it is noted that the US policy-makers also take Autonomous AI into consideration. Thus, the US approach to regulating AI is proactive and future-proofing.

Last but not least, the US government under the Biden administration has signalled a more proactive stance towards AI regulation, which brings the US closer to that of the EU.[70] For instance, the new EU-US Trade and Technology Council (TTC), an online consultation platform between the US and the EU, was established in 2021, with the inclusion of AI issues in the TTC.[71] Regarding the EU's regulatory approach to AI, it will be discussed later.

In summary, the US is the AI superpower, with the aim to maintain the American leadership in this field; as such, the US policy-makers have employed a loose, open-ended and future-

[67] Ibid.
[68] Lee (n 22). P110
[69] ibid. P110
[70] Alex Engler, 'The EU and U.S. Are Starting to Align on AI Regulation' (*Techtank*, 2022) <https://www.brookings.edu/blog/techtank/2022/02/01/the-eu-and-u-s-are-starting-to-align-on-ai-regulation/> accessed 31 December 2021.
[71] European Commission, EU-US Trade and Technology Council: Commission launches consultation platform for stakeholder's involvement to shape transatlantic cooperation, 10 October 2021, <https://ec.europa.eu/commission/presscorner/detail/en/IP_21_5308>

proofing approach in its soft and hard laws regarding AI. In its regulatory and policy initiatives, the US has considered both AI technologies that already exist (weak AI, e.g. “internet AI” and “business AI”) and future AI technologies (artificial general intelligence, e.g. “perception AI” and “autonomous AI”).

B. From a European Perspective: a flexible, coordinated approach

Considering the vital role of massive data in AI technology, the EU’s ground-breaking data regime – the General Data Protection Regulation (GDPR) in 2016 – has impacted the AI applications.[72] Nevertheless, it should be noted that GDPR is technology-neutral in its application rather than focusing on AI. While the GDPR applies to AI-related products and services in today’s data-driven, changing economy, there are currently no specific EU laws to regulate AI.

In order to fill this gap, since 2018, the EU has been working to establish a clear and predictable legal framework to govern AI. Notably, the EU’s latest effort – the 2021 AI package – is eye-catching since the EU policy-makers are working on the very first detailed set of comprehensive AI regulations on a global scale; even the AI superpowers like the US and China have not yet done so. For these reasons, this section evaluates the EU’s AI legal framework.

1. The Communication on AI for Europe of 2018

In the Communication on AI for Europe of 2018,[73] the European Commission (the Commission) introduced the EU’s first definition of AI. Furthermore, in this Communication, the Commission developed an AI strategy across EU members at the EU level,[74] and proposed measures to streamline research and policy options for AI regulation, which paved the way for a more comprehensive AI package for the EU in 2021.[75] Thus, it is meaningful to examine some details of the Communication.

At the outset of the Communication, AI is defined by the Commission as follows:

> Artificial intelligence (AI) refers to *systems* that display intelligent behaviour by analysing their environment and taking actions – with some degree of *autonomy* – to achieve *specific* goals. AI-based systems can be purely *software-based*, acting in the *virtual world* (e.g. voice assistants, image analysis software, search engines, speech

[72] Regulation (EU) 2016/679 - General Data Protection Regulation (GDPR).
[73] European Commission, ‘Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions on Artificial Intelligence for Europe’ (2018) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A237%3AFIN>.
[74] ibid.
[75] ibid. p.1.

> and face recognition systems) or AI can be embedded in *hardware* devices (e.g. advanced robots, autonomous cars, drones or Internet of Things applications).[76]

Besides this first definition of AI from the EU policy-makers, it is worth mentioning that the Commission refers to AI in various places with nuances. In some places of the Communication, the Commission considered AI to be "a *generic term* that refers to *any machine or algorithm* that is capable of observing its environment, learning, and based on the knowledge and experience gained, taking intelligent action or proposing decisions."[77] This broad definition can cover a wide range of different AI technologies. So, when facing the pacing problem and the competition from other AI leading countries, the EU policy-makers' approach is to adopt AI as a "generic term" which covers a wide range of technologies, and the EU policy-makers consider AI should be defined flexibly to promote innovation.

It is also observed that, after the EU launched its first AI definition, the Commission's High-Level Expert Group on AI maintained but further refined the first definition. The Expert Group released "A Definition of AI" on 18 December 2018 (updated on 8 April 2019).[78] In this document, the Expert Group describes AI as "*systems* that display intelligent behaviour by analysing their environment and taking actions – with some degree of *autonomy* – to achieve *specific* goals" [e.g. narrow AI mentioned above], and "AI-based systems" can be "embedded in *hardware* devices" or "purely *software*-based, acting in the virtual world".[79] So, the Expert Group's definitions are nearly identical to the first AI definition of the EU that was introduced in 2018. In addition, the Expert Group defines "AI" and "AI systems", respectively, as follows:

> Artificial intelligence (AI) systems are *software*[80] (and possibly also *hardware*) systems designed by humans that, given a complex goal, act in *the physical or digital dimension* by perceiving their environment through *data* acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. [81]

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[76] ibid. p.1.
[77] European Commission Joint Research Centre, Artificial Intelligence: A European Perspective 18 (2018).
[78] High-Level Expert Group on Artificial Intelligence—Set up by the European Commission, A Definition of AI: Main Capabilities and Disciplines (first released on 18 December 2018, updated on 8 April 2018). https://ec.europa.eu/futurium/en/system/files/ged/ai_hleg_definition_of_ai_18_december_1.pdf
[79] Ibid.
[80] Emphasis added by the current author. For instance, Internet AI as mentioned above has not physical form of hardware.
[81] High Level Expert Group, A Definition of AI, p. 8.

> AI systems can either use symbolic rules or learn a numeric model, and they can also *adapt* their behaviour by analysing how the environment is affected by their previous actions.[82]

Subsequently, in 2020, the EU continued to release a number of publications on AI regulation, arising from the Commission's intention to accelerate digital development in the EU through its adoption of a pan-European Digital Strategy. In February 2020, the Commission published a Report on the safety and liability implications of AI (hereinafter "the AI Report") and a White Paper on AI (hereinafter the "AI White Paper")[83] in order to address the aforementioned gap that exists concerning the lack of specific AI regulation in the EU. Following the Report and White Paper, the European Parliament (hereinafter 'the Parliament') adopted the texts of legislative proposals in October 2020, to introduce the EU's AI comprehensive regulatory frameworks, including "a legal and ethical framework for AI"[84] and "a civil liability framework in respect of AI products".[85]

2. The EU's AI Package of 2021

The EU's latest effort is the Commission's long-awaited comprehensive AI package, which was unveiled on 21 April 2021. Aiming to establish a "global gold standard" for AI and position Europe to play a leading role globally, the Commission's AI package consists of three parts, including:

- A proposal for an AI Regulation (also called "the AI Act" of the EU) which is the first-ever legal framework on AI in the world and lays down harmonised rules on AI across the EU member states,[86]
- a Coordinated Plan with Member States of the EU,[87] and
- a Communication on Fostering a European Approach to Artificial Intelligence.[88]

3. Aim to Make the EU Become a Global Hub

Although the EU is not an AI superpower like the US and China, the two primary aims of the

[82] Ibid.
[83] European Commission, AI White Paper, 19 February 2020, https://ec.europa.eu/info/sites/default/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf. See more https://www.arthurcox.com/knowledge/eu-developments-in-ai-regulation/
[84] European Parliament, https://www.europarl.europa.eu/doceo/document/TA-9-2020-0275_EN.html
[85] European Parliament, https://www.europarl.europa.eu/doceo/document/TA-9-2020-0276_EN.html
[86] European Commission, Proposal for a Regulation laying down harmonised rules on artificial intelligence, COM(2021) 206 final, 2021/0106(COD), (21 April 2021), https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence
[87] European Commission, Coordinated Plan on Artificial Intelligence 2021 Review, 21 April 2021, https://digital-strategy.ec.europa.eu/en/library/coordinated-plan-artificial-intelligence-2021-review
[88] European Commission, Communication on Fostering a European approach to Artificial Intelligence, 21 April 2021, https://digital-strategy.ec.europa.eu/en/library/communication-fostering-european-approach-artificial-intelligence

EU's proposed AI Act are "excellence AI" and to "turn Europe into the global hub for trustworthy AI".[89] Following the model of the EU GDPR 2016 that has had an impact on the EU member states and beyond, through the long-awaited AI package, the Commission aims to align the new AI rulebook with the fundamental EU values that AI systems must adhere to in the design, development and use. [90] So, as the first mover in launching comprehensive AI rules in the global scale, the EU's AI-specific legislation and regulatory approach will likely set standards beyond Europe, even globally, at least work as a model for other developing countries to follow in managing AI-associated risk within those countries.

4. EU's novel risk-based approach

The proposed AI Act is the result of the publication of the aforementioned AI White Paper[91] and several years of work by the Commission. In the AI Act, the Commission introduces a legal framework for AI that employs a broad AI definition, as discussed below, with a novel "risk-based approach" (see Appendix) to regulate a wide range of AI systems:

According to the Commission, "these rules will also provide Europe with a leading role in setting the global gold standard",[92] and its objective is to strike a balance between building citizens' trust in AI systems to mitigate associated risks and boosting investment and innovation in the further development of AI systems which are built upon high-quality data sets.[93] As such, the Commission has adopted a novel so-called "risk-based approach" to regulating AI, which abides by an overall rule that "the higher the risk is, the stricter the rule is' (see the table in Appendix). Accordingly, the Commission's Regulatory Framework divides associated different AI systems into four levels of risks (see Appendix). The EU policy-makers have used a holistic yet flexible approach to regulating AI systems, ranging from weak AI, to strong AI, from software-based AI, to hardware-based AI, and to some unknown means that are yet to come into existence.

Before the publication of the proposed AI Act, an online public consultation was launched on 19 February 2020 along with the publication of the AI White Paper and ran until 14 June

[89] Commission, Europe fit for the Digital Age, 21 April 2021, https://ec.europa.eu/commission/presscorner/detail/en/IP_21_1682

[90] Francine Cunningham, First-ever legal framework for AI proposes obligations for developers, users and importers, 4 May 2021, https://www.twobirds.com/en/insights/2021/global/first-ever-legal-framework-for-ai-proposes-obligations-for-developers-users-and-importers.

[91] European Commission, AI White Paper (n 83).

[92] European Commission, 'A European Approach to Artificial Intelligence' (2018) <https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence>.

[93] ibid.

2020.[94] Stakeholders have mostly requested a narrow, clear and precise definition for AI.[95] Besides the need to clarify the term "AI", stakeholders also highlighted that it is important to define "risk", "high-risk", "low-risk", "remote biometric identification" and "harm".[96] Most stakeholders explicitly supported a risk-based framework that the EU proposed to regulate AI: using the risk-based framework was considered a better option than blanket regulation of all AI systems.[97] The types of risks and threats should be based on a sector-by-sector and case-by-case approach. The risks of different AI systems should also be calculated, considering the impact on rights and safety.[98]

Bearing the above feedback from stakeholders to the public consultation in mind, when looking at the final version of the AI Act, it can be seen that the Act has taken into account the feedback from the public consultation but is not always adopted. The AI Act has not defined "AI" but rather an "AI system", stating that

> "[T]he definition of AI system in the legal framework aims to be as *technology neutral and future proof as possible, taking into account the fast technological and market developments* related to AI."[99]

Furthermore, the Commission noted that "the notion of AI system should be clearly defined to ensure *legal certainty*, while providing the *flexibility* to accommodate future technological developments."[100] On the one hand, Article 3 of the AI Act stipulates that

> (1)'artificial intelligence system' (AI system) means *software* that is developed with one or more of the techniques and approaches listed in Annex I[101] and can, for a given

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[94] European Commission, Proposal for a Regulation laying down harmonised rules on artificial intelligence (AI Act, COM(2021) 206 final, 2021/0106(COD), (21 April 2021), https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence During the consultation, in total, 1215 contributions were received, of which 352 were from companies or business organisations/associations, 406 from individuals (92%individuals from EU), 152 on behalf of academic/research institutions, and 73 from public authorities. Civil society's voices were represented by 160 respondents (among which 9 consumers' organisations, 129 non-governmental organisations and 22 trade unions), 72 respondents contributed as 'others'. Of the 352 business and industry representatives, 222 were companies and business representatives, 41.5% of which were micro, small and medium-sized enterprises. The rest were business associations. Overall, 84% of business and industry replies came from the EU-27. Depending on the question, between 81 and 598 of the respondents used the free text option to insert comments. Over 450 position papers were submitted through the EU Survey website, either in addition to questionnaire answers (over 400) or as stand-alone contributions (over 50).

[95] Ibid.

[96] Ibid.

[97] Ibid.

[98] Ibid.

[99] Ibid.

[100] Ibid. EU AI Act of 2021, Preamble, Paragraph (6).

[101] Ibid. EU AI Act of 2021, ANNEX I (ARTIFICIAL INTELLIGENCE TECHNIQUES AND APPROACHES)
referred to in Article 3, point 1.
(a)Machine learning approaches, including supervised, unsupervised and reinforcement learning, using a wide variety of methods including deep learning;

set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with.[102]

On the other hand, the AI Act states that the techniques and approaches listed in Annex I can be updated. [103] This arrangement means the Commission recognises AI is fast evolving and comprises an array of technologies, so the law should be flexible and future-proof.

Addtionally, the EU's regulatory approach regarding AI demonstrates two characteristics. On the one hand, the EU employs a proactive approach to regulating AI, similar to that of the US. On the other, the EU's approach is in a way that also showcases the EU's attributes and particularity. Like the US, European countries have taken a proactive stance towards AI regulations and policy, such as the AI-specific regulations, since 2018. Meanwhile, despite having certain competitive advantages, such as a strong scientific and industrial base to build on, leading AI research and talent, and recognised leadership in robotics and innovative start-ups, the EU has recognised it has the potential to become, but not yet, a world leader like the US and China in the AI arena.[104] Furthermore, the EU's AI strategy emphasises that European countries must jointly commit to making Europe an AI superpower at the EU level, and it is working towards a clear and predictable legal framework to ensure consumer protection and legal certainty. [105]

In summary, while the EU shares some similarities with the US and China in adopting flexible, broad AI definitions to promote innovation and "excellence AI" in Europe, the way the EU regulates also shows its particularity, such as focusing on "trustworthy AI" and the EU's fundamental values.[106] Furthermore, it is worth noting that the EU has recognised that its competitive advantages in AI have not made it an AI superpower, so European countries need to excise join forces at the EU level.[107] The EU's AI agenda states that "the main ingredients are there for the EU to become a leader in the AI revolution, in its own way and based on its values," such as safeguarding people's safety and fundamental rights and protecting

(b)Logic- and knowledge-based approaches, including knowledge representation, inductive (logic) programming, knowledge bases, inference and deductive engines, (symbolic) reasoning and expert systems;
(c)Statistical approaches, Bayesian estimation, search and optimization methods.

[102] EU AI Act Title 1 (General Provisions) Article 3 (1) Definitions

[103] EU AI Act Article 4 (Amendments to Annex I)The Commission is empowered to adopt delegated acts in accordance with Article 73 to amend the list of techniques and approaches listed in Annex I, in order to update that list to market and technological developments on the basis of characteristics that are similar to the techniques and approaches listed therein.

[104] European Commission (n 73). COM(2018) 237 final. Communication Artificial Intelligence for Europe (25 April 2018), <https://digital-strategy.ec.europa.eu/en/library/communication-artificial-intelligence-europe>. [hereinafter Communication on AI for Europe]

[105] Ibid, Communication on AI for Europe]

[106] European Commission (n 92).

[107] European Commission (n 73). <https://digital-strategy.ec.europa.eu/en/library/communication-artificial-intelligence-europe, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A237%3AFIN >

consumers.[108] Thus, divergent AI regulations have been emerging on the global scale among the first movers – the US, the EU and China.

C. From a Chinese Perspective

While some WTO members appear to be following the US approach by capturing AI along the same lines,[109] an operative definition of AI still eludes many other countries when contemplating their recent soft and hard law on AI. Back to the year of 2017, China was not an AI superpower. Surprisingly, just five years after Ke Jie's loss to AlphaGo which attracted the Chinese central government's attention and started to take action, China has become an AI superpower. So, it is interesting to examine how China upgraded its AI capacity and the interplay between law and technology in advancing AI in China.

Notably, China, another global superpower in shaping AI development, has yet to offer a clear-cut definition of AI.[110] This contribution argues that China prefers a cross-sectoral, piecemeal but flexible approach, which seems to suit China's AI technological development, since this approach has successfully boosted AI development in China and made it become an AI superpower like the US in the short run (from 2017 to now).

In 2017, with AlphaGo — a product of the British AI start-up DeepMind, which Google had acquired in 2014 — the West seemed poised to continue its dominance in the AI era.[111] However, shortly after Ke Jie's loss to AlphaGo, the Chinese central government released a comprehensive blueprint for Chinese leadership in AI. It is noted that China's AI plan originated at the highest level of the central government,[112] such as the "Mass Innovation and Mass Entrepreneurship" campaign.[113]

Moreover, China's AI plan is turbocharging growth through a flood of new funding, including subsidies for AI start-ups, generous government contracts, and soft laws to accelerate the adoption of AI.[114] For example, in 2017, the State Council released the country's strategy for

[108] European Commission (n 92). Emphasis by the current author.
[109] For instance, the EU seems increasingly aslign its AI strategy with the US. Taiwan, for instance, has attempted to define AI as broadly covering, among others, "systems acting as humans" and "systems acting rationally." See, e.g., Rengong Zhihui Fazhan Jibenfa Caoan (人工智慧發展基本法(草案) [Draft Bill of Basic Law Governing Development of Artificial Intelligence (Taiwan)], article 2. [hereinafter Taiwan AI Development Basic Law (Bill)].
[110] See, e.g., Guowuyuan guanyu yinfa xin yidai rengong zhineng fazhan guahua de tongzhi [Notice of the State Council on Issuing the Development Plan on the New Generation of Artificial Intelligence] (promulgated by the State Council, 8 July 2017).
[111] Lee (n 22). P13.
[112] E.g. the Communist Party of China (CPC) Central Committee and the State Council of PR China.
[113] State Council of PR China, More actions to promote mass entrepreneurship and innovation, 25 June 2021, http://english.www.gov.cn/premier/news/202106/25/content_WS60d589a4c6d0df57f98dbddd.html
[114] Lee (n 22). pp89-90

developing AI, entitled “New Generation Artificial Intelligence Development Plan” (AIDP).[115] This strategy paper of 2017 sets out China’s aims to become the world leader in AI by 2030.[116] In particular, China sees an opportunity to monetise AI into a trillion-yuan industry. The strategy also sets out in general terms the commitment to establish ethical norms and standards for AI, at least within the jurisdiction of China.

Driven by the Chinese central government’s and regional initiatives, China has become an AI superpower like the US in some areas of AI applications.[117] Against this backdrop, China, as an AI superpower nowadays, has recently passed three AI-related statutes as follows:

- Cybersecurity Law of the People’s Republic of China, 2016[118]
- Data Security Law of the People’s Republic of China, 2021[119]
- Personal Information Protection Law of the People’s Republic of China, 2021[120]

In summary, China prefers a cross-sectoral, piecemeal and flexible approach. It is worth noting that the above three pieces of legislation are AI-related but not AI-specific rules, unlike the EU’s AI package. Similar to the EU GDPR, these three pieces of legislation govern AI applications, due to the importance of massive amounts of data as pointed out at the outset. However, none of them is AI-specific legislation, which currently does not exist in China so far. Through checking the texts of the three legislation, the author finds that neither the Chinese Cybersecurity Law nor the Data Security Law uses the wording of AI even once; the Chinese Personal Information Protection law mentions the term AI only once, without any elaboration or definition. On the other hand, the central and local soft laws in China that have been adopted since 2017 still play an vital role in the field of AI in China, as explained above.

D. From a UK perspective

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[115] State Council of China, A New Generation of Artificial Intelligence Development Plan (AIDP) [新一代人工智能发展规划], State Council Document [2017] No. 35; there is no official translation of the strategy document at the time of writing. An unofficial translation might be found at https://flia.org/wp-content/uploads/2017/07/A-New-Generation-of-Artificial-Intelligence-Development-Plan-1.pdf. For an exposition of the AIDP, see Roberts, H., Cowls, J., Morley, J. et al. The Chinese approach to artificial intelligence: an analysis of policy, ethics, and regulation. AI and Society (2021)36, pp 59–77.

[116] Ibid.

[117] Lee (n 17).

[118] Cybersecurity Law of the People’s Republic of China [中华人民共和国网络安全法] (Adopted at the 24th meeting of the Standing Committee of the Twelfth National People's Congress on 7 November 2016), <http://www.cac.gov.cn/2016-11/07/c_1119867116.htm >

[119] Data Security Law of the People’s Republic of China [中华人民共和国数据安全法] (Adopted at the 29th meeting of the Standing Committee of the 13th National People's Congress on 10 June 2021), <http://www.npc.gov.cn/npc/c30834/202106/7c9af12f51334a73b56d7938f99a788a.shtml >

[120] China, Personal Information Protection Law of the People's Republic of China [中华人民共和国个人信息保护法] (Adopted at the 30th meeting of the Standing Committee of the 13th National People's Congress on 20 August 2021) <http://www.npc.gov.cn/npc/c30834/202108/a8c4e3672c74491a80b53a172bb753fe.shtml >

Besides China, some other countries also seem reluctant to crystalise the statutory definition of AI further for now. For instance, the UK House of Lords simply refers to "AI" as technologies with the ability to "perform tasks that would otherwise require human intelligence", bearing in mind that contemporary AI systems generally have the capacity to "learn or adapt to new experiences".[121]

Similar to China, the UK has also chosen to adopt a more technically focused but piecemeal approach to regulating AI. On the one hand, the EU GDPR 2016, which was passed before Brexit, still applies to the UK and regulates AI due to AI's reliance on data.[122] On the other, instead of adopting single all-encompassing legislation on AI, as the EU AI package, the UK has chosen to publish a National AI Strategy on 22 September 2021.[123]

Subsequently, the UK Government has launched an AI Standards Hub for the UK to shape and improve *global* technical standards for artificial intelligence. For instance, the UK is currently developing and agreeing on international technical standards working with the International Organization for Standardisation and International Electrotechnical Commission (ISO/IEC) and the Industry Specification Group on Securing AI at the European Telecommunications Standards Institute (ETSI). [124]

V. An Overview of Challenges to Global Trade Law and Governance in the Age of AI

Rapidly developing AI technologies have led to the pacing problem, not only at a national level for policy-makers from WTO members with the emerging divergent national regulatory responses, as discussed above, but also at the international level challenging global trade governance. The remainder of this contribution has twofold aims: first, to illustrate AI-associated legal challenges to the global trade governance (see the figure below); second, to shed light on the WTO Plurilateral Negotiations on Trade-Related Aspects of Electronic Commerce.[125]

The global trading system under the WTO framework mainly governs trade in goods, services and trade-related intellectual property rights (see the figure below), all of which are facing the pacing problem. Two of the most important WTO-based multilateral agreements are the

[121] UK House of Lords Select Committee on Artificial Intelligence, 'AI in the UK: Ready, Willing and Able?' (2019) <https://publications.parliament.uk/pa/ld201719/ldselect/ldai/100/10002.htm>. at 14. Likewise, other common law countries seem to loosely define the term AI.

[122] The Data Protection Act 2018 is the UK's implementation of the General Data Protection Regulation (GDPR). See more <https://www.gov.uk/data-protection#:~:text=The%20Data%20Protection%20Act%202018%20is%20the%20UK's%20implementation%20of,used%20fairly%2C%20lawfully%20and%20transparently >

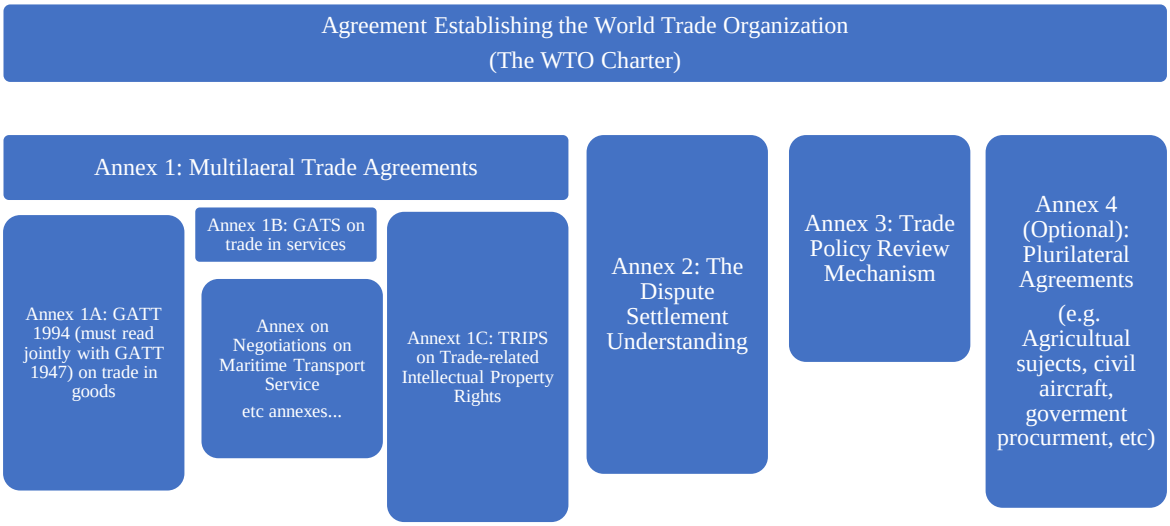
[123] UK Government, National AI Strategy: Our ten-year plan to make Britain a global AI superpower, <https://www.gov.uk/government/publications/national-ai-strategy/national-ai-strategy-html-version >

[124] Ibid.

[125] WTO, E-Commerce,< https://www.wto.org/english/tratop_e/ecom_e/ecom_e.htm >

General Agreement on Tariffs and Trade (hereinafter "GATT")[126] and the General Agreement on Trade in Services (hereinafter "GATS").[127] The third major multilateral trade agreement of the WTO is the Agreement on Trade-Related Aspects of Intellectual Property Rights (hereinafter "TRIPs"). [128] This section explores the legal issues facing the global trade governance under the WTO legal framework, particularly the GATT-GATS legal framework and TRIPs, brought about by AI technologies.

Figure 1: WTO Agreements[129]



The figure is drawn up by the author.

The figure above illustrates the overall structure and content of global trade law.

A. The Pacing Problem Arising from the Goods-Services Dichotomy

In today's global trading system, GATT is the multilateral agreement that applies to international trade in goods, whereas GATS is the multilateral agreement that governs international trade in services (see the figure above). In addition, the application of GATS varies, according to the way how a particular service is supplied; GATS defines four modes of services as to how the service is so supplied.[130] These are Mode 1 (Cross-border supply),[131]

[126] General Agreement on Tariffs and Trade, 30 October 1947, 61 Stat. A-11, 55 U.N.T.S. 194 [hereinafter GATT].
[127] General Agreement on Trade in Services Article XIV, 15 April 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1B, 1869 U.N.T.S. 183 [hereinafter GATS].
[128] Agreement on Trade-Related Aspects of Intellectual Property Rights, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 15 April 1993, 1869 U.N.T.S. 299; 33 I.L.M. 1197 (1994) [hereinafter TRIPs]
[129] Source: see the full texts of the Uruguay Rounds Agreements in WTO official website, <http://www.wto.org/english/docs_e/legal_e/legal_e.htm>.
[130] GTAS Article I.2.
[131] Services supplied from the territory of one WTO Member into the territory of any other.

Mode 2 (Consumption abroad),[132] Mode 3 (Commercial presence),[133] and Mode 4 (Cross-border movement of natural persons supplying services).[134]

The renaissance of AI with real-life applications has posed increasing challenges to the GATT-GATS legal framework, particularly the goods-services dichotomy. This is because the GATT-GATS legal framework was negotiated from 1986 to 1994, which came into force in 1995.[135] It is, therefore, worthwhile to note that the global trading system, including its GATT-GATS legal framework, was negotiated and concluded at a time when much of online activities today did not exist. So the negotiators had not considered the post-1994 blurring of the boundary between tangible goods and intangible services, which is inconsistent with the WTO's goods-services dichotomy.[136]

Furthermore, the proliferation of e-commerce over the past two decades has revealed the limitations of the existing global trade law. With the widespread use of the internet, various sorts of "digital products" – electronic goods or intangible goods that exist in digital form – which possess conventional characteristics of both "goods' and 'services" as defined under GATT and GATS, respectively, have caused difficulties in applying the GATT-GATS legal framework.[137]

1. Whether "digital products" fall within the scope of GATT, GATS, or both?

There have been debates among academics, practitioners and policy-makers on the issue of whether businesses that supply digital products, such as books or music in digital form, over the internet should fall within the scope of GATT, GATS, or both.[138] This question is fundamental, and it matters to global trade law. For example, regarding market access of "digital products" in a WTO member state, whether such products are subject to the application of GATT and/or GATS matters, because they adopt different approaches in terms of their applications: GATT adopts the negative list, but GATS utilises the positive list and has no

[132] Services supplied in the territory of one WTO Member to the service consumer of any other Member.
[133] Services supplied by a service provider of one WTO Member, through commercial presence (e.g., companies), in the territory of any other Member.
[134] Services supplied by a service provider of one WTO Member, through the presence of natural persons of a Member in the territory of any other Member.
[135] WTO, Legal Texts, <https://www.wto.org/english/docs_e/legal_e/legal_e.htm >. See also Lijun Zhao, Transportation, Cooperation and Harmonization: GATS As a Gateway to Integrating the UN Seaborne Cargo Regimes into the WTO, 27 Pace International Law Review 60 (2015), Available at SSRN: https://ssrn.com/abstract=3226314
[136] Ibid.
[137] Rolf H. Weber and Mira Burri, Classification of Services in the Digital Economy (2013). See details of the negotiating history in Sacha Wunsch-Vincent, *The WTO, The Internet and Trade in Digital Products: EU-US Perspectives* (Hart 2006). 35, 55–62.
[138] Mark Wu, Digital Trade-Related Provisions in Regional Trade Agreements: Existing Models and Lessons for the Multilateral Trade System (2017).

guarantee, regarding market access.[139]

Likewise, this aforementioned fundamental question remains unresolved nowadays and addresses the same legal problems and challenges to AI-enabled products/services. With the rise of the internet and various sorts of "digital products", the WTO has been trying to update the GATT-GATS legal framework and the corresponding goods-services dichotomy since 1998 through its Electronic Commerce Work Programme.[140] Nevertheless, after many years of hard work, little progress has been made in updating the WTO agreements. Some WTO Members, notably from the EU, argue that such "products" in question lack physical attributes; thus, they should be a service(s) and governed by GATS.[141] In contrast, other WTO Members, especially the US, insist that digitally delivered content-based products should be considered "goods" instead of "services", because of their "durability" and "inseparability" from the physical medium.[142]

2. Attempted solutions within and outside of the global trade system

There have been many attempts, both within and outside of the global trading system, to resolve the pacing problem. Within the global trading system, the pacing problem facing global trade law, particularly the GATT-GATS legal framework, has been resolved to some extent by the WTO adjudicators. In the landmark decisions of *US-Gambling*[143] and *China-Publications and Audiovisual Products*,[144] GATS was interpreted by the WTO Appellate Body to govern the cross-border trade in digital contents.[145]

Beyond the global trading system, the pacing problem associated with the goods-services dichotomy has been resolved to some extent. In the context of preferential/regional trade agreements (PTAs/RTAs), such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), electronic commerce provisions have been introduced under Chapter 14 of CPTPP.[146] In accordance with Article 14.1 of CPTPP, "digital product" has been defined as

> "a computer programme, text, video, image, sound recording or other product that is

[139] Ibid. See also Lijun Zhao, Transportation, Cooperation and Harmonization: GATS As a Gateway to Integrating the UN Seaborne Cargo Regimes into the WTO, 27 Pace International Law Review 60 (2015).
[140] WTO, E-Commerce, <https://www.wto.org/english/tratop_e/ecom_e/ecom_e.htm >
[141] Wunsch-Vincent (n 137).
[142] ibid.
[143] *United States — Measures Affecting the Cross-Border Supply of Gambling and Betting Services (AB Report, US—Gambling)* (2005) 20 April 2.
[144] *China—Measures Affecting Trading Rights and Distribution Services for Certain Publications and Audiovisual Entertainment Products (AB Report, China — Publications and Audiovisual Products)* (2010) WT/DS363/A.
[145] See details in Peter Van den Bossche and Zdouc Werner, *The Law and Policy of the World Trade Organization Text, Cases, and Materials* (5th edn, Cambridge 2021).
[146] CPTPP, Full Text, <https://www.mfat.govt.nz/vn/trade/free-trade-agreements/free-trade-agreements-in-force/comprehensive-and-progressive-agreement-for-trans-pacific-partnership-cptpp/comprehensive-and-progressive-agreement-for-trans-pacific-partnership-text-and-resources/ >

> digitally encoded, produced for commercial sale or distribution, and that can be transmitted electronically".[147]

Nevertheless, this article is accompanied by remarks in the footnotes of CPTPP, [148] stating that this definition

> "should not be understood to reflect a Party's view on whether trade in digital products through electronic transmission should be categorised as trade in services or trade in goods".[149]

3. Legal Gaps and Uncertainty of the GATT-GATS Legal Framework in the AI Era

There are two observations regarding the legal gaps in the GATT-GATS legal framework. First, as discussed above, the two streams of aforementioned efforts, that are within and beyond the global trading system, have addressed but not fully resolved the legal gap and uncertainty regarding digital products. Second, in the field of AI, the unresolved legal gap, as part of the pacing problem of global trade law under the goods-services dichotomy, will be more problematic and perplexing when the law meets the AI-enabled products/services. As noted above, different national approaches to regulating AI have emerged in a handful of AI leaders; there is an emerging tendency that WTO Members will likely adopt different national approaches to regulating AI-enabled products/services. For instance, while the EU launched the first-ever comprehensive AI legal/regulatory framework (ie. the EU's AI pack mentioned previously) with an ambition to make its proposed AI Act to be a model for the rest of the world to follow when regulating AI technology,[150] this contribution has identified that other AI powers, particularly the US, China and the UK, have been working on their own national approaches to regulating AI. As such, the rest of the WTO Members in the world are facing at least a handful of emerging divergent models for regulating AI technology.

In order to explain the pacing problem under the GATT-GATS legal framework, this contribution uses AI-enabled legal services (ie, legal AI, AI lawyers, or robot lawyers[151]) to illustrate the mismatch between fast-developing AI technology and the existing global trade law. Assuming that AI technology will continue to develop and mature as predicted by AI experts such as Kai-Fu Lee, legal AI can be divided into the four categories, depending on the level of intelligence and automation (from low to high) as follows:

- Level 1 Legal AI: Specialised standalone technologies (e.g. legal chatbots);
- Level 2 Legal AI: Enablers of legal advice (e.g. automated document review);

[147] Ibid, CPTPP, Article 14 .1 (Definitions – "Digital Products").
[148] Ibid, CPTPP, Article 14 .1 (Definitions – "Digital Products"), and accompanying footnotes 2 and 3.
[149] Ibid.
[150] Euronews, EU's artificial intelligence law should serve as 'model across the globe', 25 October 2021.
[151] AI in Law and Legal Practice – A Comprehensive View of 35 Current Applications (July 2021) <https://emerj.com/ai-sector-overviews/ai-in-law-legal-practice-current-applications/ >

- Level 3 Legal AI: Further enablers of legal advice (e.g. legal data analytics); and
- Level 4 Legal AI: Human-free smart contracts (i.e. a kind of general AI; not necessarily an AGI, but an AI with a high degree of automation).[152]

While we are not yet at Level 4 (i.e. general AI, as explained earlier), AI lawyers, with ability at the other three levels, already exist in our lives. The existing AI lawyers are usually run through website platforms or mobile apps; so foreign users may access such an AI lawyer easily via the internet. For instance, there exist some website-based AI lawyers in the US and China, including:

- "ROSS Intelligence" in the US and Europe (it is a leading AI-enabled computer program that uses natural language processing to help conduct legal research and document review on US laws[153])
- "Xiao Xia",[154] a leading legal AI on Chinese law which is based on a website, an online platform called China Legal Service Network[155] by the Chinese Ministry of Justice;
- "Bao Xiaohei"[156], which is owned and run by a company in Hangzhou, China, and
- "AI Legal Counsellor" of Zhongshan Municipal Bureau of Justice of China[157].

Readers should remember that all existing AI lawyers are weak AI, not general AI, at least not yet. However, it is foreseen by many AI experts that AI will replace human labours, including human lawyers — especially the entry-level positions, such as paralegals and first-year associates.[158]

Therefore, advanced legal AI of Level 3 or above will be technologically feasible, and it is merely a matter of time before they emerge to present new challenges to the GATT-GATS legal framework. Take a legal AI that is run in China as an example in this section, since literature in English rarely discusses AI lawyers in China, but there are some about legal AI in the US.[159] In China, several AI lawyers projects have been undertaken by the central

[152] Ibid. See also Han-Wei Liu and Ching-Fu Lin, 'Artificial Intelligence and Global Trade Governance: A Pluralist Agenda' (2020) 61 Harvard International Law Journal 61. P421.
[153] ROSS Intelligence ("ROSS") builds AI-driven products to augment lawyers' cognitive abilities, <https://rossintelligence.com/about-us >. As of 31 January 2021, the ROSS platform will no longer be available, and the ROSS platform was shut down, because Thomson Reuters and Westlaw brought a spurious lawsuit against ROSS on the ground of copyrighted data on judgments being used by ROSS without authorisation.
[154] Lv Pin Ltd, Xiao Xia Legal AI,< https://www.lvpin100.com/#/pro_xiaoxia >
[155] Through online platform of the ministry of justice <https://ai.12348.gov.cn/api/speed-front/freeReading?url=/pc/ >, this legal AI issue advanced legal opinion for clients, free of charge. Up to 1 June 2022, 2,876,071 professional legal opinions have been issued.
[156] Bao Xiaohei, Free AI lawyer, <https://pc-bxh.ai-indeed.com/ >
[157] AI Legal Counsel of Zhongshan Municipal Bureau of Justice (Guangdong province, China), launched from 2 April 2020, https://m.thepaper.cn/baijiahao_6796505
[158] Lee and Wang (n 3).
[159] See legal AI in the US in Liu and Lin (n 152).

government, local governments, and enterprises.[160] Thus, the availability of massive data (such as massive information on judgments for AI lawyers) is essential for legal AI systems: this is a problem for some legal AI systems in the US, such as the ROSS as mentioned above, since the data of judgments are not available in the public domain but privately owned by databases (e.g. Westlaw) of big corporations, such as Thomas Router; however, the availability of massive data for legal AI is not a problem in China, because Chinese courts publish judgments to the public for free in a database launched by the Supreme Court of China that include all judgments from all Chinese courts since 2013.[161] As such, similar to the statutory definitions of AI discussed above, this contribution identifies and discusses legal challenges associated with legal AI over global trade law, when AI-enabled legal services in question are supplied in a cross-border context:

Based on the discussion above, current WTO law has not clarified whether digital products/services, such as legal AI, are subject to GATT, GATS or both. Regarding the answer to this issue in question, there is not much difference between AI and the aforementioned digital products/services. Next, if the AI lawyer were treated as "services", a follow-up question is whether the services provided by a foreign AI lawyer are through Mode 1 or 2 "modes of provision"[162] of services in the eyes of GATS? However, as noted above, this legal issue is also unresolved both within and beyond the WTO, which is built mainly upon the GATT-GATS legal framework and the corresponding goods-services dichotomy.

Now, it is time to use AI lawyers as an example of AI-enabled digital products/services to illustrate the legal challenges that AI poses to the GATT-GATS legal framework. Firstly, it is unclear whether a WTO Member bans website-based "foreign AI lawyers", such as ROSS or Xiao Xia, from providing legal advice in cross-border situations? Technically speaking, legal AI is not a "lawyer" under current law, unless most WTO Member countries amend their national laws on AI's personhood (legal personality or alike) to recognise AI's independent personhood from its inventors (e.g. programmers).

For a detailed analysis, China and its GATS commitments are used here[163] to illustrate the legal uncertainty of legal AI products/services in cross-border trade settings. Suppose a website-based "foreign" AI lawyer provides its products/services in a WTO Member, such as China; in this hypothetical scenario, China's GATS Schedule on the Chinese legal services

[160] AI legal services embedded in Gov.cn, https://ai.12348.gov.cn/pc/ (having issued 2,698,767 pieces of legal opinions, each of which covers legal analysis and advice in detail. Zhongshan Municipal Bureau of Justice, AI legal advisor, http://www.zs.gov.cn/zssfj/gkmlpt/content/1/1722/post_1722215.html#1128. Bao Xiaohei" project, a personal legal adviser, in Hubei Provincial Government Portal of China, The AI Entrepreneurship Competition of the Central Venture Capital Conference (2019-06-28).

[161] China Judgment Online [database], <https://wenshu.court.gov.cn/ >(judgments from 2013 are all published in this Chinese Supreme Court led database).

[162] See GATS (n.130, 131, 132, 133, and 134).

[163] The selection is because of China's prominent role in global trade and AI techonogy.

sector is governing law. After searching the WTO's GATS Schedule database, it is found that China has submitted its GATS-specific schedule on the legal services sector (CPC 861, excluding Chinese law practice).[164] When applying the GATS specific schedule to website-based ROSS-like "foreign" AI lawyers in China, some legal uncertainties exist as follows:

Firstly, regarding Modes 1 and 2 and corresponding concessions that China made to the legal service sector, the specific schedule shows that China inscribes "None" in relation to this sector.[165] Thus, there are no limitations specific to this sector.[166] Also, it is controversial whether such a foreign AI lawyer, such as a ROSS-like legal AI, has received legal education and training to be eligible for sitting in an accredited bar exam in the country of the legal AI; for example, the US bar exam for ROSS.[167] That is why the previous analysis mentioned that it is unclear in reality whether a WTO member would ban website-based "foreign" AI lawyers.

Secondly, regarding Mode 3 and corresponding concessions that China made to the legal service sector, "foreign law firms" and "foreign representative offices" can consult the laws of a jurisdiction, in which "the lawyers of the law firm are permitted to engage in the lawyer's professional work."[168] When it comes to a foreign AI lawyer, it is problematic whether the foreign AI lawyer with the presence of *physical hardware or equivalent* in China constitutes and fulfils the concepts of "foreign law firms" and "foreign representative offices" stated in China's concession mentioned under Mode 3. So, this is another legal uncertainty.

In addition, assuming that AI will continue to mature and legal AI will reach Level 4, regardless of such legal AI system being embodied in physical robotics, hardware, software only, or any future forms that are unknown yet, the Level-4 legal AI will also propose new challenges to the WTO legal framework:

One of the key challenges is that if a Level-4 foreign AI lawyer (not necessarily an AGI, but an AI with a high degree of automation) is embodied in a physical form (not necessarily a humanoid) and it is traded in a cross-border context, then it is legally uncertain under current GATT-GATS legal framework whether GATT or GATS regulates such a transaction; if GATS regulated the hypothetical scenario, the probably most significant legal uncertainty would exist when the legal AI is providing service in Mode 4 of GATS, compared with that involving Modes 1, 2 and 3. The legal uncertainty is caused by several reasons:

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[164] WTO, China's GATS Schedules: Specific Commitment (legal services sector included), Doc. GATS/SC/135 (14 February 2002). See full text from <https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S009-DP.aspx?language=E&CatalogueIdList=71613,11725,21775,25776,34016&CurrentCatalogueIdIndex=2&FullTextHash=&HasEnglishRecord=True&HasFrenchRecord=True&HasSpanishRecord=True >

[165] Ibid.

[166] WTO, Guide to reading the GATS schedules of specific commitments and the list of article II (MFN) exemptions, https://www.wto.org/english/tratop_e/serv_e/guide1_e.htm

[167] Liu and Lin (n 152).

[168] See *China—Schedule of Specific Commitments,* WTO Doc. GATS/SC/135 (14 Feburary 2002) [China—GATS Commitments].

Firstly, the current WTO case law has identified ambiguity in the goods-services dichotomy. Notably, in *China—Publications and Audiovisual Products*, the WTO Appellate Body held that "where the content of a film is carried by a physical delivery materials", China's restrictions will "inevitably regulate who may import goods for the plain reason that the content of a film is expressed through, and embedded in, a physical good."[169] So, GATT may potentially apply, provided that the legal AI is embodied in the physical medium, regardless of being human-shape or other shapes.[170]

Secondly, WTO Members have developed divergent national regimes on the above legal issue of whether the presence or absence of physical forms affect the application of law and adopted different national laws. Some countries, such as the US and the EU countries, have recognised software as "goods".[171] By contrast, English law, notably in the case of *St Albans City and District Council v International Computers,* is "as discs were certainly goods, software that was delivered on a disc would be goods too, but a software program, in itself, does not amount to goods."[172] Therefore, it is likely that divergent national regimes to this legal question will continue to exist for some time, affecting the whether GATT or GATS is applicable.

Another key challenge is that the above legal problems will be intensified. Because some WTO Members are considering recognising the legal personhood of robot lawyers, such as the EU,[173] but some other countries have no such plan yet. If this sort of law confirming AI's legal personhood becomes effective in some WTO Members, it is uncertain whether robot lawyers (e.g. Legal 4 legal AI) be subject to Mode 4 of GATS.[174] Similar to the emerging divergent national regimes on AI definitions, WTO Members have revealed divergent answers to the question of the AI's legal personhood.

B. Emerging Divergent National AI Regulations and Impact on TRIPs Agreement

TRIPS, which came into effect on 1 January 1995, is the most comprehensive existing multilateral agreement on intellectual property rights.[175] This contribution argues that, in addition to challenges facing the GATT-GATS legal framework as discussed above, TRIPs also faces the pacing problem that it has shown TRIPs to fall short in keeping pace with the

[169] *China—Measures Affecting Trading Rights and Distribution Services for Certain Publications and Audiovisual Entertainment Products (AB Report, China — Publications and Audiovisual Products)* (n 144). Paragraph 188.
[170] See also UK case law on the Sale of Goods Act 1979 as amended in 1994 and 1995 on software, and relevant case law.
[171] see e.g. CJEU Case referred by UK – Software Incubator v Computer Associates (2021).
[172] [1996] 4 All ER 481 (CA)
[173] For instance, during the public consultantion, the EU proposed to legal personhood of AI, but objections were addressed by AI experts in a joint letter, and the EU parliament then abaondon the proposal.
[174] Liu and Lin (n 152).
[175] WTO, Overview: The TRIPS Agreement, https://www.wto.org/english/tratop_e/trips_e/intel2_e.htm

fast-evolving AI technologies.[176] In real life, AI has become a tool for painting, poetry writing, and journalism;[177] for instance, Washington Post, Forbes, Bloomberg, Reuters and Guardian have used their robot-writing AI systems.[178] However, it is legally unclear who is "author" or "inventor" of the AI-enabled algorithmically authored works.

Therefore, whilst TRIPs has facilitated the harmonisation of intellectual property law globally through implementing minimum standards among WTO Members, TRIPs has shown a tendency to fail this task in the age of AI. On the one hand, TRIPS is a minimum standards agreement and enhances the harmonisation of the law across the world. In respect of each of the main areas of intellectual property covered by TRIPS, TRIPS sets out the minimum standards of protection to be provided by each WTO Member. On the other hand, it is difficult to maintain the minimum standard approach of TRIPs in the AI era.

In regard to the emergence of divergent national regulatory approaches on a global scale, at least three different styles of national regulatory approaches have emerged to govern algorithmically authored works:

The first national approach to regulating algorithmically authored works, exemplified by the UK legislation under its Copyright, Designs and Patents Act 1988 (CDPA),[179] features more flexibility and could readily fit into the new setting of AI.[180] For example, under Section 9(3) of CDPA, for a literary, dramatic, musical or artistic work that is computer-generated, the author shall be "the person by whom the arrangements necessary for the creation of the work are undertaken". Additionally, the term "computer-generated" is defined under Section 178 of CDPA as the work "generated by computers in circumstances such that there is no human author of the work." Therefore, the UK approach protects algorithmic creations, though it leaves no room for AI itself to be an "author". Instead, authorship of algorithmically authored works will be attributed to the "the person by whom the arrangements necessary for the creation of the work are undertaken", for example, programmers of computer software.[181]

Some other countries have adopted the second national approach to regulating algorithmically authored works, notably the US. The US Copyright Law only protects "the fruits of intellectual labor" that "are founded in the creative powers of the mind".[182] Therefore, under the US-style

[176] For a general overview of challenges, see WTO, World Trade Report 2018: The Future of World Trade: How Digital Technologies are Transforming Global Commerce (2018).
[177] Lee and Wang (n 3).
[178] Jaclyn Peiser, The Rise of the Robot Reporter, New York Times, 5 Feburry 2019, https://www.nytimes.com/2019/02/05/business/media/artificial-intelligence-journalism-robots.html
[179] Legislation.gov.uk, UK Copyright, Designs and Patents Act 1988, https://www.legislation.gov.uk/ukpga/1988/48/contents
[180] Colin R. Davies, An Evolutionary Step in Intellectual Property Rights - Artificial Intelligence and Intellectual Property, 27 Computer L. & Sec. Rev. 601 (2011). 155.
[181] UK Copyright, Designs and Patents Act 1988, Section 9(3)
[182] US Copyright Act of 1976, 17 U.S.C. §§ 101-102 (1976). 162. See also U.S. Copyright Office, Compendium of U.S. Copyright Office Practices § 306 (3rd. ed., 2017).

national legislation, such a nation "will not register works produced by a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author."[183] So, under this type of national legislation, it seems neither the human creator nor the AI itself is entitled to claim the authorship.

More recently, a third regulatory approach has emerged in Europe along with the increased computer power and the EU's ambition to become a global hub in the AI age. In the EU, according to Article 2 (1) of the Computer Directive and Article 4 (1) of the Database Directive, "author" is defined as a "natural person" or group of natural persons who create it (e.g AI); however, there is a proviso here that the EU permits national laws of EU Member countries to designate the legal person as the right holder.[184] This leads the discussion to the aforementioned question on the personhood of AI applications and emerging divergent national answers to this question. [185]

Therefore, considering the existing three national approaches of AI powers in the field of trade-related intellectual property rights in mind and the leading roles of the US, EU and UK in the AI domain, this contribution argues that with the emergence and rise of AI, the big picture of global trade law in the area of TRIPs will become more fragmented, perplexing and diversified.

VI. Conclusion

Believe it or not, that age of AI has already arrived. According to AI experts, what we already have in AI is a whole spectrum of abilities, from programs that are smart but not so smart as humans, to super-clever programs in specific areas that outperform humans, even human champions.[186] Take playing Go, one of the specific areas, as an example. The remarkable duel between AlphaGo and Ke Jie in 2017 attracted worldwide attention and became a showcase of the capability of existing AI systems. Google's AI – AlphaGo – runs on deep learning, a ground-breaking approach to AI that has turbocharged the cognitive capabilities of machines.

This contribution finds that AI lacks a universally agreed definition. The EU and the US have been the first movers, passing some soft and/or hard laws. At the same time, some other AI leading countries, such as China and the UK, are reluctant to crystalise the definition of AI and have only passed AI-related legislation instead of AI-specific legislation.

Nevertheless, one can extract some commonalities from these emerging regulatory approaches adopted by the major AI countries. First of all, most policy- and rule-makers share a view that the concept of AI is a generic one that encompasses a wide range of technologies

[183] US Copyright Act of 1976, 17 U.S.C. §§ 101-102 (1976). 162. See also U.S. Copyright Office, Compendium of U.S. Copyright Office Practices § 306 (3rd. ed., 2017).
[184] Directive 2009/24/EC, of the European Parliament and of the Council of 23 April 2009 on the Legal Protection of Computer Programs, 2009 O.J. (L 111/16).
[185] See more in Liu and Lin (n 152). Pp433-435.
[186] Lee and Wang (n 3).

— algorithms, big data, expert systems, machine learning, deep learning, robotics, and so forth.[187] Many regulators/legislators also agree that AI is not limited to a specific form: it can be run through software (e.g. a virtual assistant) or embodied in hardware devices (e.g., a robotic vacuum), or a mixture of both.[188]

Secondly, while the term "intelligence" remains a context-specific term, it has become increasingly common for many rule-makers to join industries and academics by classifying AI as "narrow/weak AI" and "general/strong AI".[189] Narrow AI is capable of performing specific tasks.[190] By contrast, general AI, refers to that which "exhibits apparently intelligent behaviour at least as advanced as a person across the full range of cognitive tasks";[191] it is essentially "intellectually indistinguishable from a human being."[192] According to the two definitions above, both AI experts and policy-makers agree that we are not yet at the stage of general AI so far; all existing AI, including those that outperform their human counterparts, even human champions, in many areas like playing Go, disease diagnosis, car driving, and drone aircraft still fall within the scope of narrow AI.[193] Still, AI technology is fast developing and will continue to mature and become general AI. This is why many aforementioned legislation/regulations nicely avoid static definitions of AI in legislation and regulations to make the law future-proof.

Policy-makers, at both international and national levels, can utilise these commonalities to create a common ground for initial talks on managing the challenges in the field of AI. When designing a new legal framework, one should also bear in mind the fast-evolving landscape of technology and the inequality between countries, to capture this trendy term by allowing flexibility to accommodate different approaches to defining AI. Based on examining definitions of AI, this contribution concludes that the term AI is broadly understood to cover both narrow AI and general AI, which follows the approach of the AI experts, and the US and the EU legislators/regulators.

The different national regulatory approaches further reinforce the divergent landscape for global trade governance. A handful of AI powers like the EU and US have passed specific law governing AI. Some countries have chosen to pass AI-related law by regulating data which play a critical role in AI technology. Due to the significant role of data in AI systems, these laws also affect AI. For example, the EU introduced its data regulation – the GDPR 2016, as well as in the UK; China also passed the Personal Information Protection Law of the People's

[187] See, e.g., UK House of Lords Select Committee on Artificial Intelligence (n 121). at 14–15; Communication on AI for Europe, at 8–10
[188] Communication on AI for Europe, at 1.
[189] See, e.g., UK House of Lords Select Committee on Artificial Intelligence (n 121). at 15; US Preparing for the Future of AI, (n.47), at 7.
[190] ibid. at 15.
[191] US Preparing for the Future of AI, supra (n.47), at 7.
[192] UK House of Lords Select Committee on Artificial Intelligence (n 121). at 15.
[193] ibid. at 15. Lee and Wang (n 3).

Republic of China in 2021.[194]

Based on the comparative analysis of emerging divergent regulatory responses to the rise of AI technologies, this contribution examines the gaps and legal uncertainty in existing global trade law. It argues that, in addition to challenges facing the policy-makers at national levels, the policy-makers also face the pacing problem at the international level. This contribution evaluates the insufficiency of global trade law in the AI age through examining the GATT-GATS legal framework and TRIPs, and it is shown that all of the three multilateral agreements of the WTO have problems in keeping pace with the fast-evolving AI technologies.

Appendix:

Table 1：The European Commission's Regulatory framework proposal on artificial intelligence

Risk levels associated with AI systems	Effects	Examples
Unacceptable risk	Such AI systems are prohibited, since they are deemed to be against EU fundamental rights and values.	Examples of the prohibited AI systems include: • Exploitative or manipulative practices, such as 'practices that have a significant potential to manipulate persons through subliminal techniques' • AI-based social scoring carried out by public authorities.
High risk	Such AI systems are allowed *only if* they comply with certain mandatory requirements comprising: data governance, documentation and record	• The identification of high-risk AI will be closely linked to their intended purpose and includes systems used in the following sectors: critical

[194] See the comparision between the EU and Chinese Data Protection Laws in Osborne Clark, The PRC Personal Information Protection Law, China's GDPR – in a nutshell (6 September 2021) https://www.osborneclarke.com/insights/prc-personal-information-protection-law-chinas-gdpr-nutshell

	keeping, transparency and provision of information to users, human oversight, robustness, accuracy and security, and *ex-ante* conformity assessments	infrastructure, educational training, hiring services, migration and border control tools, justice administration and law enforcement. • Within this high-risk AI, the Commission has included real-time biometric systems (e.g. facial recognition), which will be prohibited unless considered strictly necessary to search for a missing child, to prevent a specific and imminent terrorist threat or to locate the suspect of a serious criminal offence.
Limited risks	AI systems to which only specific transparent obligations will apply, as of making citizens aware that on the other side there is a machine (and not a human) interacting with them	chatbots
Minimal or no risks	this last group comprises AI systems that are considered not to constitute a risk or pose a threat to citizens' fundamental rights and to which no specific obligation will be applied.	

Source: Table compiled by the current author. Source: the Commission, Regulatory

framework proposal on artificial intelligence.[195]

[195] See more , <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0206&from=EN >, see also <https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai >, <https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence >, <https://www.lawfareblog.com/artificial-intelligence-act-what-european-approach-ai >

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