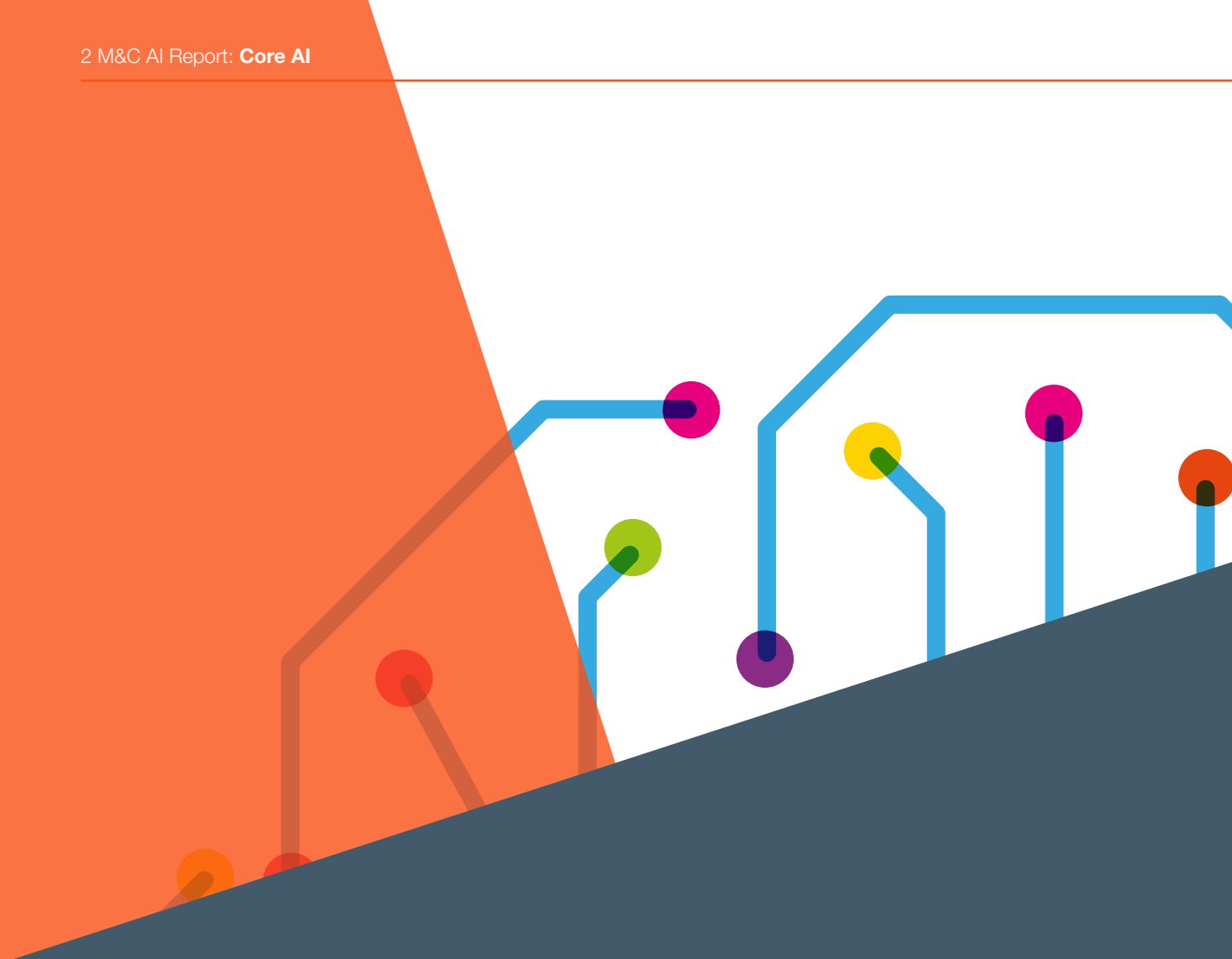


Marks & Clerk AI

Core AI patents at
the EPO – a long-term
trend analysis



“ Marks & Clerk is, in a literal sense, leading the way when it comes to filing artificial intelligence patents.



Marks & Clerk is, in a literal sense, leading the way when it comes to filing artificial intelligence patents. Our firm has the highest success rate of any firm of European patent law attorneys (excluding firms handling only a single case) with 83% of Core AI applications handled by our team granted. This compares to the overall success rate for all attorney firms of 49%. Our firm was also the second highest filer of Core AI patent applications, and, due to Marks & Clerk's very high success rate, obtained more granted patents than any other European patent attorney firm.

Our team have filed several boundary pushing AI patents in recent years and we are regularly invited to speak at industry events on the intersection of AI and intellectual property law, with Philip Martin for example having recently been invited to be part of a small

panel of experts in a plenary session at an EPO conference on AI addressing the legal and IP issues thrown up by AI.

To produce the data analysed in this report we used as a starting point IPC code and keyword definitions used for patent data in the "WIPO Technology Trends 2019: Artificial Intelligence" report (as defined in the "Data collection method and clustering scheme: Background paper" for the same report). Cases matching the definitions used for the WIPO report were identified using the Derwent Innovation database, and data from Derwent Innovation was combined with data from EP Patent Bulletin. The WIPO definitions were refined based upon manual analysis of the data. We then wrote custom formulae using the raw data to generate our own fields for the analysis.

Key findings:

- The number of AI patent applications filed at the EPO is increasing rapidly. The proportion which are for “computer systems based on biological models” – which we call “core AI” cases (IPC code G06N03) – has increased particularly sharply since 2015.
- Most patent applications for Core AI are for neural networks.
- European patent applications for Core AI are mainly filed by US and European companies, with surprisingly few from Japan or Korea.
- European applicants are more successful at the EPO than non-European applicants, and the difference in success rate is more marked for Core AI cases than for all AI cases taken together. We expect that this is due European patent attorneys being involved earlier in the process for European applicants, and due to the particular challenges for Core AI inventions.
- Marks & Clerk LLP had the highest success rate and obtained more granted patents for Core AI patent applications than any other firm of European patent attorneys.



Introduction

We have reviewed every Core AI patent application filed at the EPO closed since 2018 and in this report, we undertake a detailed analysis into some of the trends we are seeing in the data, and what they tell us about successful intellectual property strategies in the field of AI.

Artificial intelligence technology is proliferating, impacting all aspects of business and society and helping solve problems that were previously out of reach. Much of this progress has been enabled by incredible innovations in underlying AI techniques and models, or what we call “Core AI”.

Given the power of these innovations, and their often wide-ranging impacts, it is natural that innovators wish to protect the investment made in their innovations.

Patents are classified into different areas of technology using a system called IPC codes. From a European perspective, cases classified with the “G06N/3” code (“Core AI cases”) are of particular interest. G06N/3 is used for innovations in “computer systems based on biological models” – or what we refer to herein as “Core AI”. These are inventions in underlying AI techniques themselves, rather than application of AI to particular problems. Why is this classification of particular interest in Europe? The European Patent Office’s (EPO) approach to these cases is to start from the position that they are “mathematical methods”. At the EPO, inventions are excluded from patentability insofar as the invention relates to a mathematical method “as such”.

Of course, the distinction between innovations that are and are not mathematical methods “as such” has been subject to legal dispute and a body of case law has developed over the last forty years. While this case law is now well-established, its application to artificial intelligence presents an interesting challenge for the EPO that they are currently grappling with.

These challenges are most clearly seen in those cases classified with the G06N/3 IPC code. A G06N/3 classification indicates that the innovation lies in neural networks and related models themselves. Patent applications can have more than one IPC code classification and our analysis looks both at cases with a G06N/3 classification alongside other classifications (eg chemistry, transportation, education), as well as cases only classified as G06N/3 (suggesting that the innovation lies only in neural networks and related models).

EPO Guidelines for Examination

Under the EPO’s approach to mathematical methods (which was updated in a November 2018 update to the Guidelines for Examination) an innovation that is deemed to be a mathematical method (eg an innovation in Core AI) is patentable either if it relates to a technical application of the mathematical method (for example it is used in image processing, in an industrial process, etc) or if it relates to a technical implementation of the mathematical method.

While European Patent No. EP1569128B was granted by the Examining Division in 2015 (before the introduction of the specific Guidelines for AI), it is a useful example of an AI-related mathematical method that would likely fall within the second safe harbour. The claim related to a “computer-implemented method for processing a computer application”, but did not recite a specific technical application (so could not avail itself of the first safe harbour). The claim did, however, include a detailed recitation of how a central processing unit (“CPU”) interacts with a graphics processing unit (“GPU”) to perform a machine learning technique, and specified various types of data that are communicated between the CPU and GPU.



The proportion of AI cases classified as G06N/3 has increased sharply... reflecting the increasing importance of biologically-inspired computer systems in AI.

Rise of the machines?

So, what does a search of EPO patent filings classified as G06N/3 reveal? As we see in the below graph, filings in this category have increased sharply, from 31 in 2015 to 501 in 2019. While this partly reflects the overall trend in increased filings in AI, the proportion of applications classified as G06N/3 has also increased sharply, from an historical average of 2% to around 10% in 2019.

This more rapid increase in Core AI cases compared to overall AI cases reflects the increasing importance of new developments in neural networks as AI becomes increasingly pervasive.

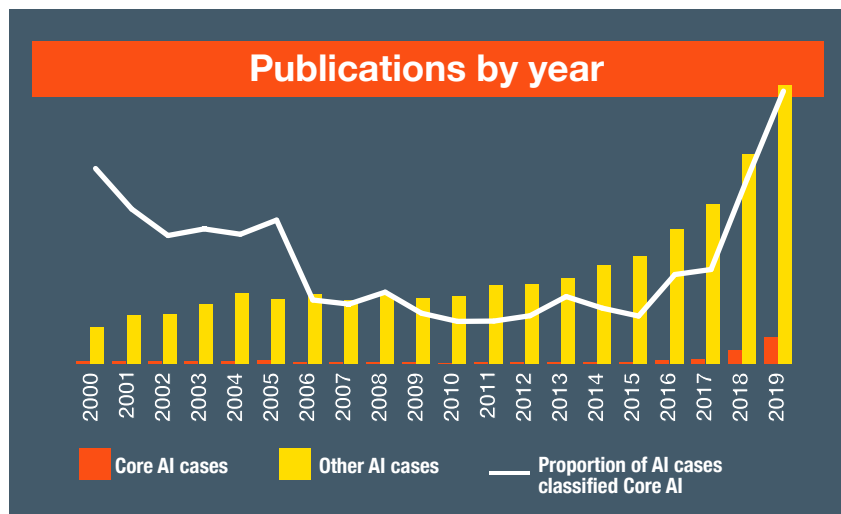


Figure 1

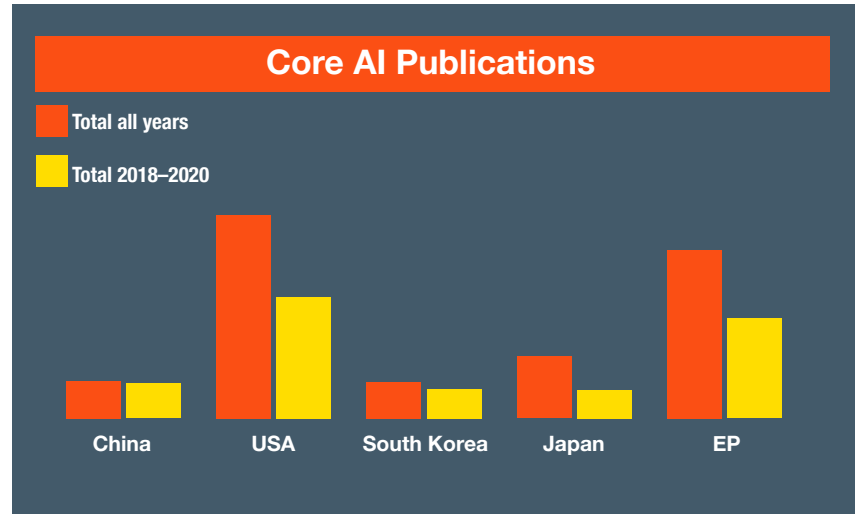


Figure 2

Analysis of publications by applicant country unsurprisingly reveals the US as the largest filer of Core AI cases, both across the past 20 years and since 2018. European applicants filed the second largest number of Core AI cases by some margin across the two periods, with the gap between European applicants and US applicants almost exactly the same across the two periods (European applicants having 82% of the number of US applicant publications in both periods). Japan is the next highest filer across the 20 year period, but is overtaken by both China and Korea since 2018. Interestingly,

of the 133 Core AI cases published by Chinese applicants in the past 20 years, 92% were published since 2018. Chinese applicants move from fifth to third in the number of Core AI case publications since 2018. This highlights a significant change in behavior of Chinese applicants in recent years, likely as a result of China's widely reported increased focus on AI.

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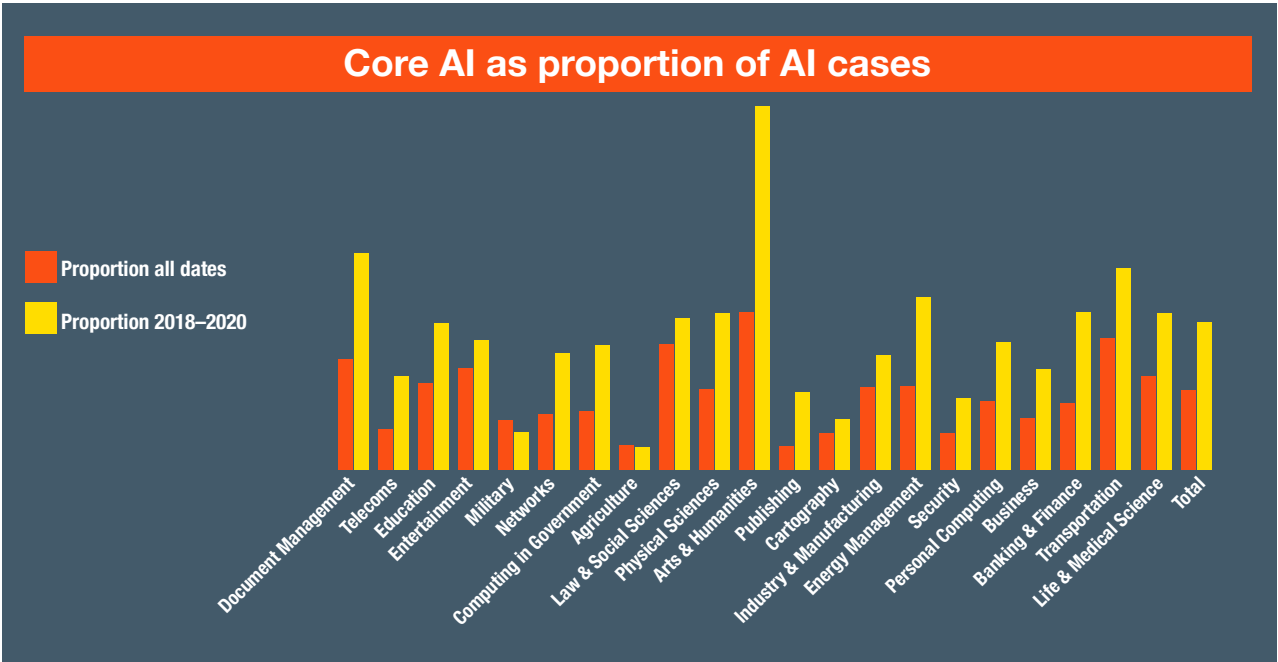


Figure 3

Our analysis has also classified cases based upon industry sector. For each industry sector, we have examined the proportion of Core AI cases (Figure 3), both in the last 20 years, and since 2018. Our analysis found an uneven and fluctuating distribution of Core AI cases across industries.

Unsurprisingly given the overall trend, the prevalence of Core AI cases across most industry sectors has increased. “Military” and “Agriculture” are the only two exceptions, although these are two of the industry sectors with the lowest proportion of Core AI cases. This suggests that applicants in these sectors are more focused on applying existing AI models to solve problems than to innovation in the models themselves.

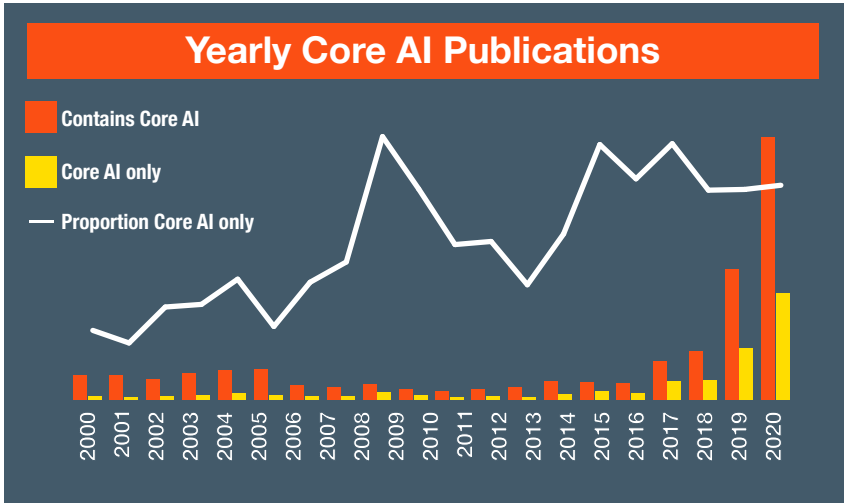
The three industry sectors with the highest proportion of Core AI cases since 2018 are Arts & Humanities (17%), Document Management (10%) and Transportation (9.5%). The proportion of cases in Arts & Humanities and Document Management has increased dramatically since 2018 relative to the past 20 years, more than doubling in both cases. Given that both of these areas are generally more challenging to protect before the EPO, it is perhaps an indication that applicants in these areas have tried to focus on protecting the underlying model, possibly motivated by the increased clarity provided by the November 2018 EPO guidelines update. Transportation has seen a rise more consistent with the overall

increase in Core AI cases and maintained its position as an area of innovation in Core AI.

Of the Core AI cases (ie those classified as G06N/3), there is also an increase in cases that are classified as only G06N/3, perhaps reflecting an increased desire to protect developments to underlying models rather than their application to particular technical field. This is a challenging objective in Europe, though it is possible for certain Core AI inventions (see pull out box on EPO guidelines).

The EPO considers itself “well prepared” for the rapid growth of AI applications¹. It has increased the number of examiners capable of handling this subject matter, and has been closing significantly more cases in the past few years (the EPO closed 121 Core AI cases in 2019, up from 74 only the year before). However, our experience, and the EPO’s own comments, suggest there remains a small pool of expert examiners with AI expertise, and the EPO has some difficult years ahead.

Figure 4



1. See the remarks of Mr Yann Ménière, Chief Economist at the EPO, at the EPO’s conference “Patenting Artificial Intelligence”, May 2018.

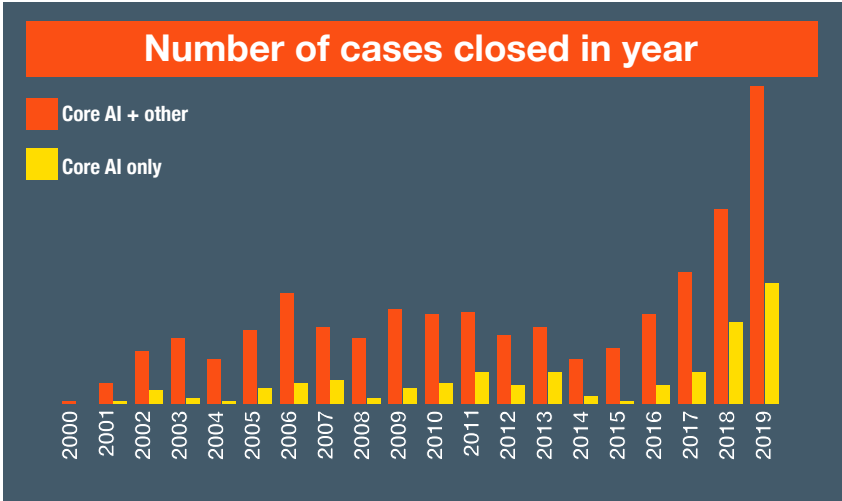


Figure 5

The increased capacity, and a seeming effort to close very old cases in the previous few years, has resulted in a large drop in average pendency times. Cases closed² in 2019 had an average age of 2.6 years compared to over 7.5 years in 2017.

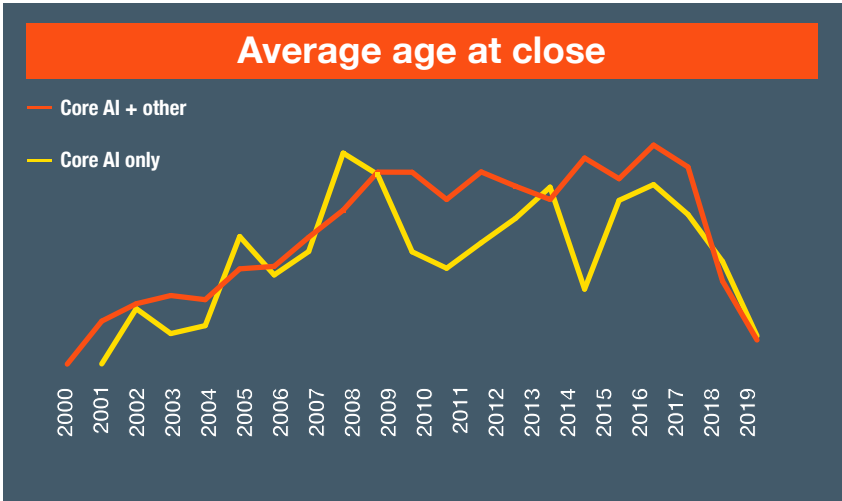


Figure 6

2. Granted, or which in some other way stopped pending.

However, unless the EPO's examination capacity increases significantly again, the reduction in pendency is likely to be short-lived, as the number of pending cases is increasing sharply, even allowing for an apparent delay in the EPO indicating cases as deemed withdrawn.

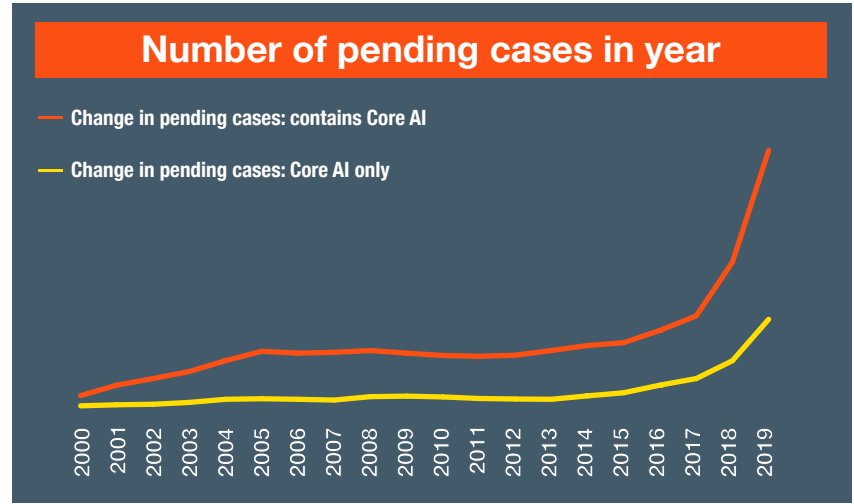


Figure 7

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Patenting AI at the EPO – what does the data show?

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US applicants dominated the Core AI cases.

Now that we understand which industries are filing AI patents, and how the EPO are handling these applications, what can the data tell us about which filing strategies are most effective? To obtain more detailed insights, Marks & Clerk studied all the Core AI cases closed by the EPO since 2018³. A large majority of these Core AI cases were neural network (NN) cases⁴.

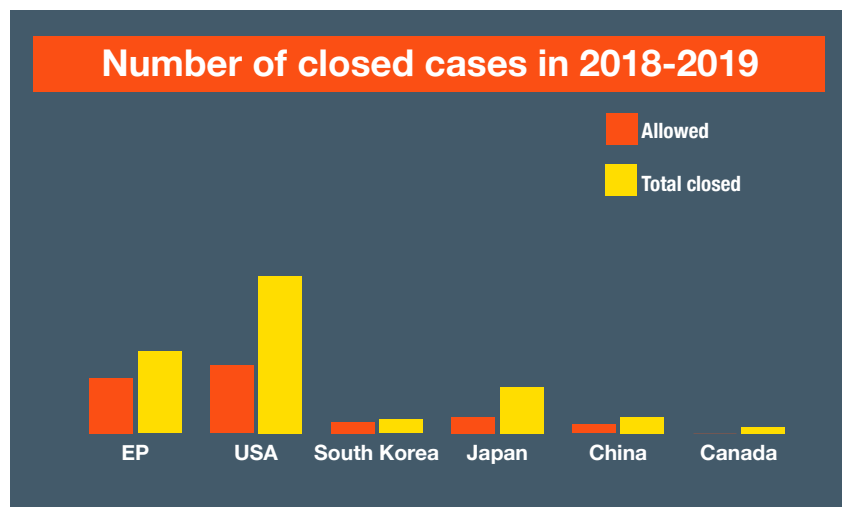
As the below graph demonstrates, US applicants dominated the patent filings for Core AI.

We saw fewer closed core AI cases from Chinese applicants than expected – China is the second-highest filer of applications

relating to “computer technology”, but only 13 core AI cases were closed between 2018 and 2020.

We know that alongside the US, China is one of the world’s leading investors in AI. So, at first sight it is surprising to see the number of cases closed in the period from Chinese applicants so low. However, as highlighted above, 92% of all Core AI cases from Chinese applicants were published since 2018 and are likely still making their way through the patent system. The proportion of Core AI cases from Chinese applicants closed will undoubtedly increase in coming years.

Figure 8



3. The “study period” was January 2018 to 30 June 2020. We analysed all cases having G06N/3 as one of their IPC classifications which were closed (granted, or which in some other way stopped pending).

4. 63% of applications required a neural network in an independent claim (referred to here as “NN” applications), and 86% either did this or described an implementation using a neural network in the description.

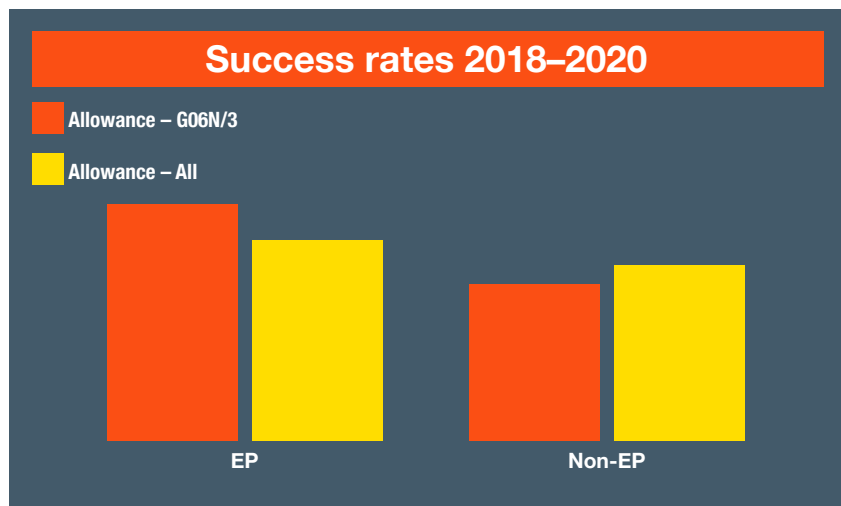


Figure 9

Defining “success rate” as the proportion of cases closed in the study period (from January 2018 to July 2020) which led to granted patents, European patent applicants had significantly higher success rates (68%) than non-European patent applicants (45%) for Core AI cases since 2018. While European applicants are more successful (57%) than non-European applicants (50%)

across all AI cases, the difference in success rate is markedly better for Core AI cases. We suspect that European patent attorneys were involved with the drafting of very few of the cases from non-European applicants, and they were written to conform to requirements of the applicant’s home patent office rather than those of the EPO. The particular challenges for Core AI cases in

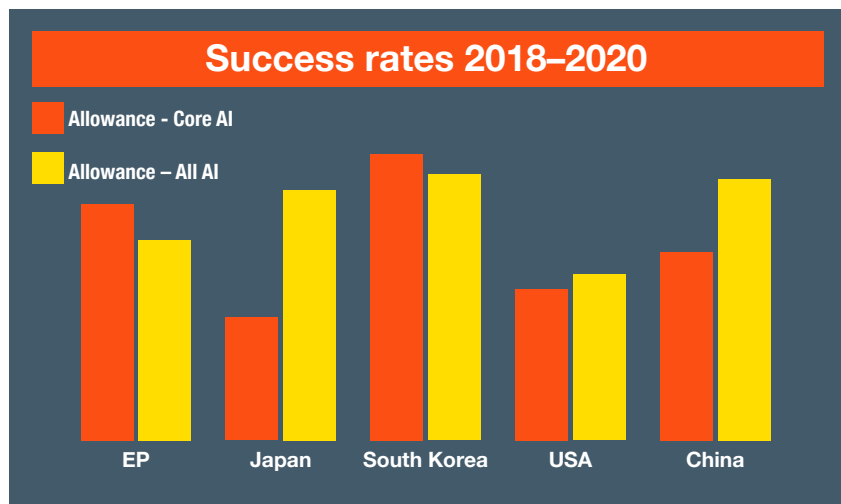


Figure 10

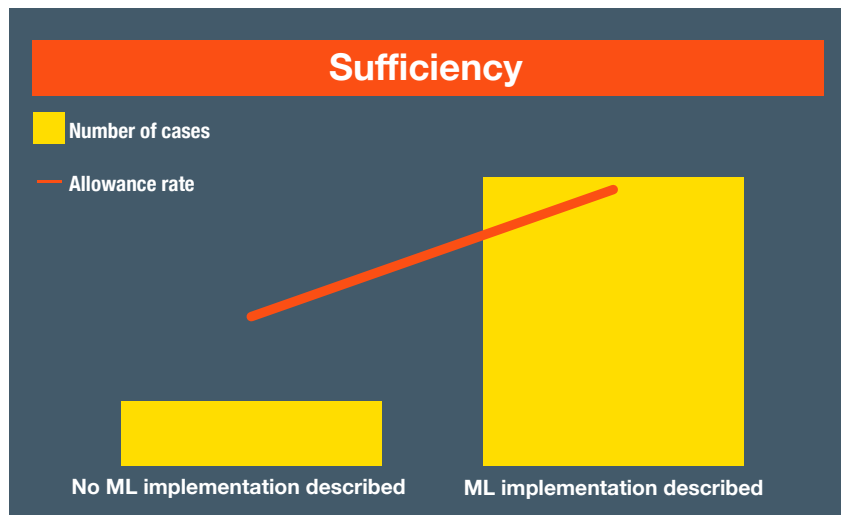


Figure 11

Europe, and the need to draft patent applications with these challenges in mind, seems to be highlighted in this data.

Comparing the success rates of applicants from individual countries reveals significant variation in success rates, although it must be noted that the absolute number of Core AI cases filed in the period by applicants from Japan, Korea and China is small. While most applications described a neural network, or other form of Machine Learning (ML) implementation, a number of applications described no ML implementation at all. The impact on the success rate between these two approaches was stark. While applications that describe at least some form of ML implementation have a greater than 50% success rate, this drops to below 30% for those applications

that do not adequately describe an ML implementation. These applications are almost certainly being rejected as non-technical (mathematical methods *as such*) or for lack of sufficiency.

While the absolute numbers are small, looking at the countries of applicants that have filed applications that do not describe any ML implementation, we see that Japan has the most applications. Again, we suspect that these applications may have been prepared without the involvement of a European patent attorney that has significant experience in preparing applications directed to this area of technology.

Almost all Core AI patent applications were filed by commercial companies. Only 8% had at least one applicant which

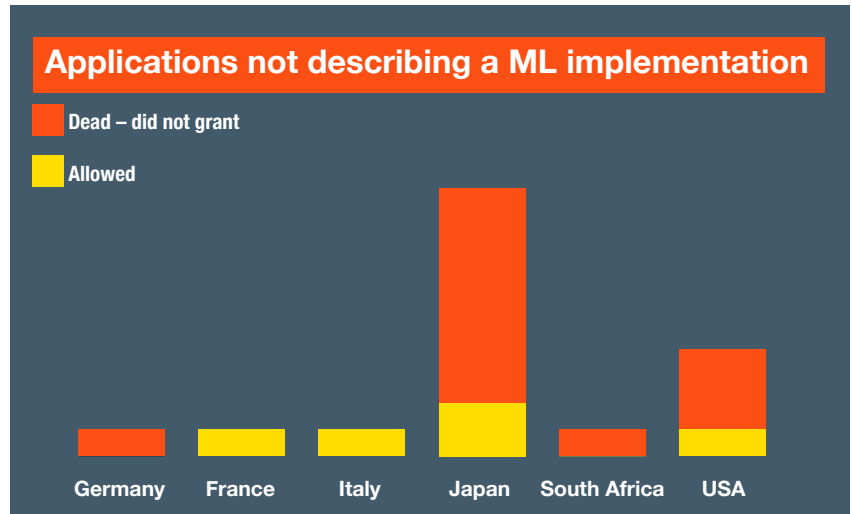


Figure 12

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was a research institute, university or individual. The leading applicant (measured by the number of applications which named them or a subsidiary as an applicant) was Qualcomm.

The work of examining these patent applications was done by a relatively small number of examiners, with 41% of cases handled by one of three individuals. We noticed significant differences in the proportion of cases which different European patent examiners allowed.

Only a few cases that closed in the study period went to oral proceedings (6%), and these had about the same success rate as other cases at the EPO.

Although applicants seem increasingly interested in patenting fundamental AI inventions, rather than specific use cases, almost 99% of Core AI cases which are limited to use cases, cover only a single use case. The most popular use cases are controlling a technical process (11% of cases), image classification (8% of cases), image synthesis (5% of cases), simulating a technical process (5% of cases), and audio classification (3% of cases). Protecting multiple use cases presents challenges in Europe (see pull out box), however we have found that with the right approach, many examiners will allow multiple use cases. Given the number of cases that cover only a single use case, it seems that few European attorneys have appreciated this.

Multiple Use Cases

Under Rule 43 of the EPC, the EPO generally allow only a single claim in each “claim category” (e.g. method and apparatus). This presents a problem for Applicants that have a widely applicable AI invention that is not tied to a particular implementation (and so cannot use the second safe harbor).

While the first safe harbor enables applicants to protect specific technical applications of their AI inventions, many of the inventions

classified as in G06N/3 can bring important improvements to many different technical applications. For example, while an inventor may have developed a new training technique for facial recognition models, the same training technique may also be particularly good for training models to process lidar signals. Applicants’ priority is normally to ensure protection for the most important technical application, but ensuring protection covers

as many technical possible applications as possible can be extremely valuable.

There are ways to work within the EPO’s restrictions on numbers of claims, and within the Guidelines on AI, to gain protection for multiple technical applications. The best ways to achieve this will vary from case to case and so it is particularly important to work with a specialist in this area.

Allowance Trends

Turning to trends over time, we could discern no particular trend in allowance rates of AI cases over the past 20 years. Indeed for Core AI cases, the monthly grant rate hardly changed between the 2018 and 2019 Guidelines updates. However, it does initially appear that following the 2019 Guidelines update, the monthly grant rate of Core AI cases, and NN cases in particular, increased substantially. This effect was visible even in the months before COVID-19 could have had an impact, and may suggest that the EPO is becoming more friendly to AI inventions. However, it must be noted that the way in which cases become withdrawn, and the timing of when cases are indicated as withdrawn will mean that any conclusions on allowance rates in the most recent six months have to be treated with caution. We will revisit this issue in future reports. More anecdotally,

a more friendly environment for AI inventions is something that Marks & Clerk attorneys have noticed from their daily practice.

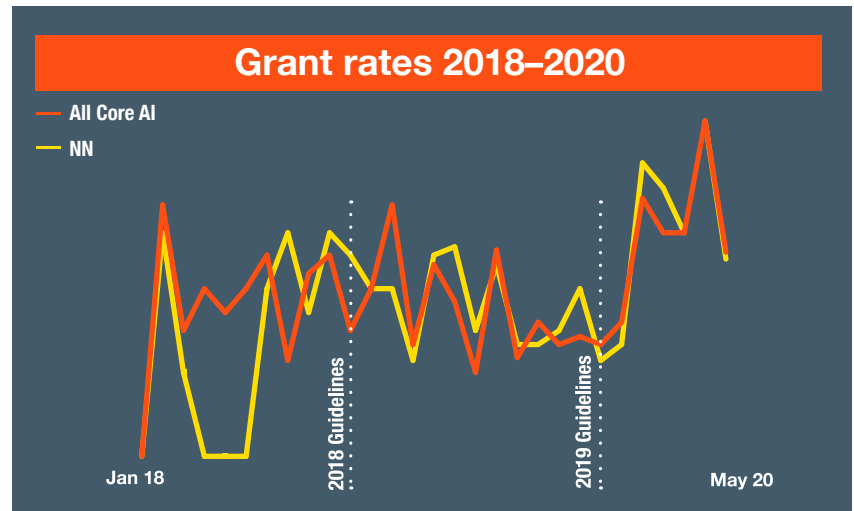
Assuming that the authorized representatives of the closed cases did not change between filing and grant, **Marks & Clerk LLP had the highest success rate of any firm of European patent law attorneys** (excluding firms handling only a single case). 83% of Core AI applications handled by Marks & Clerk LLP were granted. This compares to the overall success rate for all attorney firms of 49%.

Marks & Clerk LLP was the second highest filer of Core AI patent applications, and, due to Marks & Clerk’s very high success rate, obtained more granted patents than any other European patent attorney firm.

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Following the 2019 Guidelines, AI cases, and NN cases in particular, increased substantially... and may suggest that the EPO is becoming more friendly to AI inventions.

Figure 13



Conclusion

Filings in this category have increased sharply since 2015, and at a faster rate than the general trend of filings in AI. We see that neural networks are overwhelmingly the dominant form of AI that applicants are seeking to protect. While there is discussion amongst some researchers about different approaches to AI, this is not (yet) reflected in patent filings at the EPO.

Our analysis of industry sectors reveals that “Core AI” is a

foundational technology, like the internet, that will impact every industry in the coming decades.

We have found that applications filed by European applicants are more successful at the EPO than those filed by non-European applicants, with Marks & Clerk in particular having the highest success rate of any firm of European patent attorneys in this area.

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