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PREMIÈRE PARTIE (A)
SYNTHÈSE DE DOCUMENTS

Contenu du dossier : trois articles et un document iconographique pour chaque langue. Les documents sont numérotés 1, 2, 3 et 4.
Sans paraphraser les documents proposés dans le dossier, le candidat réalisera une synthèse de celui-ci, en mettant clairement en valeur ses principaux enseignements et enjeux dans le contexte de l'aire géographique de la langue choisie, et en prenant soin de n'ajouter aucun commentaire personnel à sa composition.
La synthèse proposée devra comprendre entre 600 et 675 mots et sera rédigée intégralement dans la langue choisie. Elle sera en outre obligatoirement précédée d'un titre proposé par le candidat.

SECONDE PARTIE (B)
TEXTE D'OPINION

En réagissant aux arguments exprimés dans cet éditorial (document numéroté 5), le candidat rédigera lui-même dans la langue choisie un texte d'opinion d'une longueur de 500 à 600 mots.

A – Document 1

Creating an AI can be five times worse for the planet than a car

Donna Lu, *New Scientist.*
6 June 2019.

Training artificial intelligence is an energy intensive process. New estimates suggest that the carbon footprint of training a single AI is as much as 284 tonnes of carbon dioxide equivalent – five times the lifetime emissions of an average car.

Emma Strubell at the University of Massachusetts Amherst in the US and colleagues have assessed the energy consumption required to train four large neural networks, a type of AI used for processing language.

Language-processing AIs underpin the algorithms that power Google Translate as well as OpenAI's GPT-2 text generator, which can convincingly pen fake news articles when given a few lines of text.

These AIs are trained via deep learning, which involves processing vasts amounts of data. "In order to learn something as complex as language, the models have to be large," says Strubell.

A common approach involves giving an AI billions of written articles so that it learns to understand the meaning of words and how sentences are constructed.

To measure the environmental impact of this approach, the researchers trained four different AIs – Transformer, ELMo, BERT, and GPT-2 – for one day each, and sampled the energy consumption throughout.

They calculated the total power required to train each AI by multiplying this figure by the total training time reported by each model's original developers. A carbon footprint was then estimated based on the average carbon emissions used in power production in the US.

A process called the neural architecture search (NAS) – which involves automating the design of a neural network through trial and error – was particularly energy intensive and time-consuming. Training Transformer without NAS takes 84 hours, but more than 270,000 hours with it, requiring 3000 times the amount of energy. Such training is split over dozens of chips and takes months to complete.

Its inefficiency stems from the need to fine-tune the model for very specific tasks, such as translating from one language to another, says Strubell.

Big tech firms such as Amazon and Google offer cloud-based platforms that researchers can pay to use remotely for training AIs. To get a more accurate picture of the associated carbon footprint the analysis would have to account for the actual energy mix these companies use.

Amazon's energy sources are comparable to the breakdown across the US, says Strubell. However, this may be changing as the company is investing in wind and solar farms, and according to its website was powered by more than 50 per cent renewable energy last year. Amazon declined to comment on the research.

Similarly, Google has long-term agreements with renewable energy suppliers, which reduces the carbon emissions associated with AI training processed by its data centres.

"From an energy perspective, and from a carbon reduction perspective, we should be thinking about designing the services and making sure the algorithms are efficient as possible," says Chris Preist at the University of Bristol.

The research will be presented at the Annual Meeting of the Association for Computer Linguistics in Florence, Italy in July.

A - Document 2

Why we should care about the environmental impact of AI

Thomas Griffin, *Forbes*.
17 August 2020.

Artificial intelligence (AI) is a subject of great debate when it comes to ethics, but one area people might not think about is its carbon footprint.

[...]

Whether it's the latest AI or machine learning algorithm that's active on a system, a new 5G network deployed at a commercial building or people streaming the latest Twitch gaming video, people generate and consume a lot of data. All that data must be captured, stored, analyzed and sent back out, which requires significant amounts of processing power. How can the tech industry deal with the increasing environmental cost of AI and its supporting systems while still providing the same service consumers demand?

Just think of all the technology that surrounds you today. Now, think about all the data it generates, sends, consumes and analyzes. It's hard for our human brains to comprehend the sheer amount of it floating around, but it's forecast to be more than 33 zettabytes (ZB) right now. By 2025, we'll top 175 ZB worth of data being stored globally. (That's 175 trillion gigabytes, or 175 plus 12 zeros.)

Keeping data centers cool enough to allow AI and other processing devices to work efficiently is going to get harder every year. Some technology has gotten better at reducing the amount of heat they produce, and we're virtualizing a lot more of it, but it's not enough. The amount of processing and edge technology that networks need, and that consumers are demanding, make those gains moot. Some analysts have noted that analytics and machine learning are driving up the heat density of data centers again, to the point that they're having the same problem as they did a decade ago.

The problem of cooling data centers, plus the knowledge that their carbon footprint is expanding and becoming more of a global problem, is leading the technology industry to think more strategically about cooling. Global awareness of climate change and how the technology industry can help is just one of the reasons they're investing in it. Many AI and data center customers are also starting to demand their vendors and suppliers take responsibility for their part in climate change and are looking for vendors that are demonstrating it.

Cloud providers like Microsoft have announced their intentions to be carbon neutral by 2030 by developing tools to help customers understand the carbon footprint of their Azure deployments. Amazon Web Services (AWS) has committed to using more renewable resources, such as wind and solar energy farms. Even independent colocation facilities are getting in on sustainability. Switch, a colocation provider with facilities located primarily in the U.S., has been running on green energy since 2016. The company has even constructed a solar power facility in Las Vegas, which it uses to power its facilities and remove the equivalent of 50,000 cars off the road.

Liquid cooling in data centers has become more popular as it's more efficient than air cooling and can handle the higher temperatures cutting-edge processing technology emit. Jayarama

Shenoy, vice president of technology at Hyve Solutions, explained to TechTarget that "Most data centers use three main types of liquid cooling: closed-loop liquid cooling, water-based cooling and liquid immersion cooling."

Liquid cooling is more efficient at cooling because it can be installed closer to the device that needs it. That's got the added advantage of lowering electricity costs because they use less electricity overall. It uses fewer kilowatt-hours to cool high-level processing devices, lowering overall cooling costs for the data center and reducing the carbon footprint.

Another exciting development in data center cooling is facilities that use their local geography for natural cooling. Locating facilities in colder climates such as Scandinavia reduces the amount of energy needed to cool them. In many industries, Iceland uses geothermal cooling technology, and some are using it to cool their data centers. Verne Global, a high-performance data center in Iceland, has been using it for over a decade, offering 100% free cooling year-round for its customers.

Learning more about the environmental impact of AI and other emerging technologies is the responsibility of the technology industry. We've all got to understand how we're affecting more than our target customers and learn about ways we can minimize our impact. It's one thing to say we're committed to the environment and donate to climate change causes. It's quite another to take proactive steps to ensure our technology keeps both people and the planet in mind. We're all in this together.

A - Document 3

Can AI light the way to smarter energy use ?

Angeli Mehta, *Reuters Events.*
24 June 2019.

Climate change is our starkest challenge: could artificial intelligence help us meet it? There's seemingly no aspect of the efforts we need to make that couldn't be accelerated by artificial intelligence. In April, a report by PwC and Microsoft suggested that across four key sectors – agriculture, energy, transport and water – AI could enable a cut in global greenhouse gas emissions of between 1.5% and 4% by 2030, with its impact greatest in transport (up to 1.7%) and in energy (up to 2.2%).

AI could also potentially create between 18.4m and 38.2m net jobs across the sectors the report's authors examined. However, these positive impacts depend on other innovations, such as distributed generation and storage, and an industrial internet of things (IoT).

AI itself requires large amounts of computing power, also requiring energy – and adding to the challenge.

In a recent presentation, Mustafa Suleyman co-founder of Google's DeepMind said: "Many of our most challenging problems are intractably complex. We've got tonnes and tonnes of data, but trying to extract insight from that data and learn the relationship between cause and effect well enough to make meaningful predictions ... is becoming more and more challenging."

Today's AI systems aren't anywhere close to re-creating human intelligence, but they are good at rapidly making sense of vast amounts of data – discerning patterns where we can't. Moreover, machine-learning algorithms can acquire knowledge from the data they analyse, so models become more accurate over time, helping humans to make better decisions. That might be to select the most fuel-efficient route for a ship, or to predict how weather systems will impact the output of a wind farm.

Suleyman wants AI to do good; to have an impact. The DeepMind team decided to pitch their efforts at two challenges: cutting energy consumption, and getting more renewable energy into the grid. [...]

What if we could use AI to cut the energy we consume in using all our consumer or business devices? Smart meters are meant to help us do that, but can only show the total amount of electricity being consumed (at approximately 10 second intervals), so it's not easy to work out which are the most energy-consuming devices.

UK firm Verv is changing that by applying machine learning to deduce which appliances are on in a household, and what they're costing. Each electrical device has its own voice – an electronic signature that can be separated out through pattern-recognition technology. Verv's technology can sample data one million times every second. "I liken it to having a microphone in a room and lots of people talking at the same time," says Maria Kavanagh, Verv's chief innovation officer.

She reckons Verv's current system has the potential to cut energy use in the home by about 10%.

Our connectedness is using vast amounts of energy. In 2016, Netflix's indirect energy use (that's you and me watching programmes downloaded from data centres) was 100,000 megawatt hours (MWh); by 2018 it had almost doubled to 194,000 MWh. This use of energy will skyrocket with the advent of 5G applications like autonomous vehicles. [...]

Vigilent, based in Oakland, California, is one of the signatories to the Step Up Declaration, an initiative launched by former UNFCC head Christiana Figueres at last year's Global Climate Action Summit in California. The coalition of 22 tech companies, including Salesforce, Autodesk, BT, Cisco, HP, and Uber, pledged to harness technology to help reduce emissions across all economic sectors, starting with their own.

Vigilent has committed that, together with its data centre partners, it will "use AI to eliminate wasteful cooling in data centres and telecom facilities, cutting annual carbon emissions by 50 million metric tons." By deploying AI globally, it anticipates carbon emissions could be cut by 10 times as much.

Cliff Federspiel, Vigilent's president and chief technology officer, says Vigilent is in the process of extending its technology to commercial buildings, where efficiency measures are urgently needed. In the longer term, he says, "I do think the technology can be delivered to other types of process industries – food processing, pharmaceuticals, indoor agriculture by using the same algorithm." But for now Federspiel believes data centres are where the biggest impact on carbon emissions can be made. [...]

AI could also be important in helping the UK deliver on its ambitious target, announced last month, to be net-zero carbon by 2050.

The National Grid had already set a target for Britain's electricity system to be zero-carbon by 2025. Meeting it will mean maximising the renewable energy fed into the grid from a vast array of producers – from individuals to industrial-scale producers.

One of the challenges is in anticipating how much renewable energy will be available – a problem by no means confined to the UK. Barcelona-based Nnergix is using AI to give grid operators, energy traders and producers around the world highly accurate energy forecasts for solar, wind and hydro production in the hours and days ahead. Its systems can also help investigate sites for their energy generating potential. [...]

DeepMind, too, has been working on making wind energy more competitive with fossil fuels.

Last year, Google started applying machine-learning algorithms to part of its fleet of renewable energy projects. Using weather forecasts and historical turbine output data, it trained a neural network to predict what wind output would be 36 hours in advance.

This proved to be a complex task because output was so variable. The team is still refining the algorithm, but says the machine learning has boosted the value of Google's wind energy by 20%, because it can now tell the grid in advance when and how much energy a given wind farm will deliver. [...]

Back in the UK, Verv believes AI could be deployed to better predict electricity demand in order to keep the grid in balance.

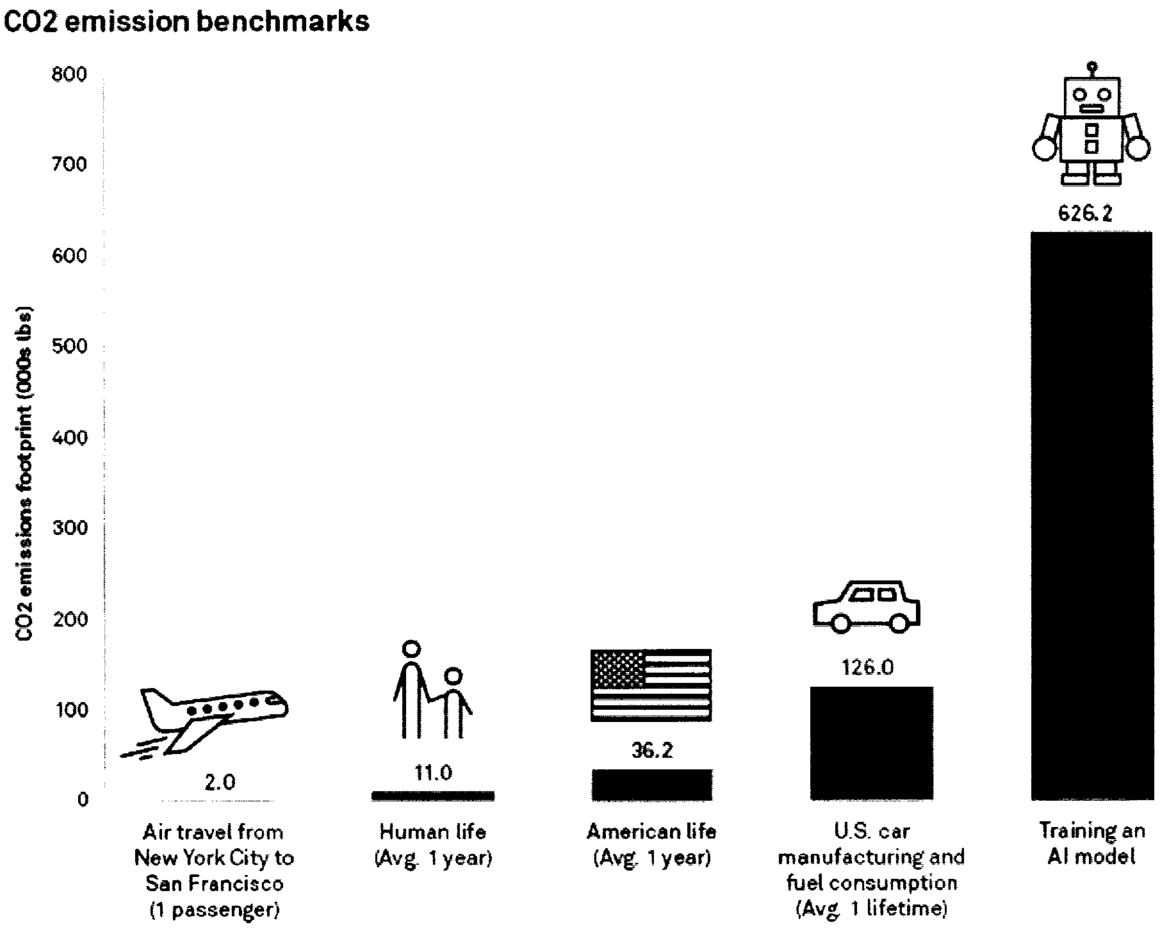
"Think of each electricity substation ... and imagine you have a battery there and a community could store its excess energy, and was incentivised to do so," suggests Kavanagh. Add in smart-plugs, and AI could be used to enable the grid to manage sudden surges in energy demand by briefly switching off – say – all the fridges in an area rather than having to call on expensive back-up generation from fossil fuel plants. Where, when and for how long to switch off are the kind of rapid decisions that can be made using AI. [...]

She points out that consumers will need to have an incentive to share their data.

But the changing shape of the grid, made possible by AI, may ultimately lead to a fairer energy system. [...]

A - Document 4
Environmental Sustainability and AI

21 August 2020, *Forbes*.



Data compiled Oct. 9, 2019.
An "American life" has a larger carbon footprint than a "Human life" because the U.S. is widely regarded as one of the top carbon dioxide emitters in the world.
Source: College of Information and Computer Sciences at University of Massachusetts Amherst

B – Document 5
The Guardian view on the future of AI: great power, great irresponsibility

1 January 2019.

Looking over the year that has passed, it is a nice question whether human stupidity or artificial intelligence has done more to shape events. Perhaps it is the convergence of the two that we really need to fear.
Artificial intelligence is a term whose meaning constantly recedes. Computers, it turns out, can do things that only the cleverest humans once could. But at the same time they fail at tasks that even the stupidest humans accomplish without conscious difficulty.

At the moment the term is mostly used to refer to machine learning: the techniques that enable computer networks to discover patterns hidden in gigantic quantities of messy, real-world data. It's something close to what parts of biological brains can do. Artificial intelligence in this sense is what enables self-driving cars, which have to be able to recognise and act appropriately towards their environment. It is what lies behind the eerie skills of face-recognition programs and what makes it possible for personal assistants such as smart speakers in the home to pick out spoken requests and act on them. And, of course, it is what powers the giant advertising and marketing industries in their relentless attempts to map and exploit our cognitive and emotional vulnerabilities.

The Chinese government's use of machine learning for political repression has gone much further than surveillance cameras. A recent report from a government thinktank praised the software's power to "predict the development trajectory for internet incidents … pre-emptively intervene in and guide public sentiment to avoid mass online public opinion outbreaks, and improve social governance capabilities".
Last year saw some astonishing breakthroughs, whose consequences will become clearer and more important. The first was conceptual: Google's DeepMind subsidiary, which had already shattered the expectations of what a computer could achieve in chess, built a machine that can teach itself the rules of games of that sort and then, after two or three days of concentrated learning, beat every human and every other computer player there has ever been.
AlphaZero cannot master the rules of any game. It works only for games with "perfect information", where all the relevant facts are known to all the players. There is nothing in principle hidden on a chessboard – the blunders are all there, waiting to be made, as one grandmaster observed – but it takes a remarkable, and, as it turns out, inhuman intelligence to see what's contained in that simple pattern.

Computers that can teach themselves from scratch, as AlphaZero does, are a significant milestone in the progress of intelligent life on this planet. And there is a rather unnerving sense in which this kind of artificial intelligence seems already alive.

Compared with conventional computer programs, it acts for reasons incomprehensible to the outside world. It can be trained, as a parrot can, by rewarding the desired behaviour; in fact, this describes the whole of its learning process. But it can't be consciously designed in all its details, in the way that a passenger jet can be. If an airliner crashes, it is in theory possible to reconstruct all the little steps that led to the catastrophe and to understand why each one happened, and how each led to the next. Conventional computer programs can be debugged that way. This is true even when they interact in baroquely complicated ways. But neural networks, the kind of software used in almost everything we call AI, can't even in principle be debugged that way. We know they work, and can by training encourage them to work better.

But in their natural state it is quite impossible to reconstruct the process by which they reach their (largely correct) conclusions.

It is possible to make them represent their reasoning in ways that humans can understand. In fact, in the EU and Britain it may be illegal not to in certain circumstances: the General Data Protection Regulation (GDPR) gives people the right to know on what grounds computer programs make decisions that affect their future, although this has not been tested in practice. This kind of safety check is not just a precaution against the propagation of bias and wrongful discrimination: it's also needed to make the partnership between humans and their newest tools productive.

One of the least controversial uses of machine learning is in the interpretation of medical data: for some kinds of cancers and other disorders computers are already better than humans at spotting the dangerous patterns in a scan. But it is possible to train them further, so that they also output a checklist of factors which, taken together, lead to their conclusions, and humans can learn from these. It's unlikely that these are really the features that the program bases its decisions on: there is also a growing field of knowledge about how to fool image classification with tiny changes invisible to humans, so that a simple schematic picture of a fish can be specked with dots, at which point it is classified as a cat.
More worryingly, the apparently random defacement of a stop sign can cause a computer vision system to suppose that it is a speed limit. Sound files can also be deliberately altered so that speech recognition systems will misinterpret them. With the growing use of voice assistants, this offers obvious targets to criminals. And, while machine learning makes fingerprint recognition possible, it also enables the construction of artificial fingerprints that act as skeleton keys to unlock devices.

The second great development of the last year makes bad outcomes much more likely. This is the much wider availability of powerful software and hardware. Although vast quantities of data and computing power are needed to train most neural nets, once trained a net can run on very cheap and simple hardware. This is often called the democratisation of technology but it is really the anarchisation of it. Democracies have means of enforcing decisions; anarchies have no means even of making them. The spread of these powers to authoritarian governments on the one hand and criminal networks on the other poses a double challenge to liberal democracies. Technology grants us new and almost unimaginable powers but at the same time it takes away some powers, and perhaps some understanding too, that we thought we would always possess.