

Artificial intelligence, real benefits



There are many stereotypes and preconceptions about artificial intelligence, fuelled in no small part by science fiction books and films. But in reality AI should be considered as a tool, albeit a highly sophisticated one that is constantly evolving and improving as our human intelligence deepens. Following the launch of the EU's coordinated plan on artificial intelligence to accelerate the development of this key technology for the benefit of all, Roberto Viola takes a look at how AI is in fact already very much a part of our day-to-day lives.

What makes AI different from any other type of tool is the ability to learn and act accordingly. In the same way that human intelligence has allowed us to flourish as a species by turning our collective hand to pretty much anything, it is the ability of artificial intelligence to improve so many different aspects of our lives that is so exciting.

The other enduring image of AI is that of a future technology (even if many of the popular culture examples set their AI-dominated world of the future in what is now our past). But in fact AI is already a day-to-day reality for many of us, from apps that know what kind of music we like without us asking to 'personal assistants' on our smartphones or in our homes that can seemingly answer any question we may have in a matter of seconds. Yet these simple examples are just scratching the surface of what AI can do. Artificial intelligence is already making us healthier, giving us cleaner air and energy, keeping us safe online or on the move and improving the quality of our work.

The popular culture view of AI is of intelligent robots – essentially artificial bodies driven by artificial intelligence – and it is certainly true that these two technologies can be put together for a myriad of uses. Robots have been used for many years to do things that humans cannot or do not want to do, from repetitive tasks on a production line to defusing explosives. But adding AI into the mix vastly expands the scope of what a robot can do. For example, one European consortium has developed an AI-driven robot that can learn everyday tasks such as making pizza or reloading the printer, things that are not difficult for humans to do but which have largely been beyond the reach of even the most sophisticated robots until now. And if this was not enough to fill the stereotype of the domestic robot of the future, lending a hand around the home like any human family member, at least two different European research projects are working on developing robots that actually dream, processing experiences during 'down time' and potentially learning how to react to new and different situations.

Keeping us healthy

If the domestic robot is the most common image of AI, the technology is in fact being used to help humans in many other fields, allowing us to push the boundaries of our own knowledge and skills. Nowhere is this more evident, perhaps, than in the field of healthcare, where AI can help both doctors and patients.

One European project is tackling the issue of breast cancer screening, for example. Current screening techniques lead to 10-20% of patients being wrongly informed that they do not have breast cancer, and tissue-sampling methods are lengthy and often inaccurate. Researchers are now developing a more accurate technique that overlays MRIs scans taken by AI-driven robots with images from ultrasound and pressure sensors to give a much clearer view of potentially diseased areas, in turn making it easier to target the area for tissue samples. Another European project is working on a remote surgery robot to assist surgeons, using virtual reality and AI to understand the surgeons' intentions and perform some of the simple tasks carried out by their human assistants during surgery.



Where machines really can outperform humans is in their capacity to process and analyse much larger quantities of data. Even 'normal' AI can work more rapidly than a human brain – although human input is always needed at the beginning to define the algorithms the AI uses in its analysis – but in some cases the quantities of data, and the complexity of the issue, require an entirely superior level of computational power behind the AI.

The complexities of how the human body works is a case in point. To effectively model and analyse this most complicated of 'machines' requires a much bigger computer 'brain' in many cases, which is where the supercomputer comes in. There are an increasing number of these behemoths appearing across the world, including several in Europe where the

best-known example is probably the MareNostrum supercomputer in Barcelona, Spain, immortalised by novelist Dan Brown in his book *Origin*, where it is the computing power behind his fictional AI character, Winston.

MareNostrum is very much real, however, and its ever-increasing computational power is being used in a number of ways to improve our understanding of the human body. For example, it can analyse huge quantities of genomic data to broaden our understanding of how cancer affects the human body, and to develop protein and drug models that could lead to personalised medical treatments based on each patient's specific needs. MareNostrum is also being used to develop extremely accurate virtual models of the human heart, helping doctors and surgeons learn more about the way this vital organ works – a project that is so cutting-edge that Brown specifically mentions it in *Origin*.

Meanwhile, a team of scientists from the Jülich supercomputing centre in Germany are leading a pan-European project designed to improve artificial intelligence understanding more effectively how the human brain works. The Human Brain Project, which also includes supercomputers from across the EU, including MareNostrum, is not only developing extremely detailed models of the human brain, but also using complex simulations to learn how the brain actually works. This ambitious and ground-breaking project has massive potential benefits for both human healthcare and advancing the development of AI in the future.

Keeping us moving and safe

If there is one autonomous, intelligent machine that has particularly captured the imagination of the public in recent times, it is the self-driving car. There are more than 1.3m road accident-related deaths each year according to the World Health Organisation (of which around 25,000 were in the EU), and cutting out the human error that is so often the cause of these tragedies is the chief goal of the self-driving car.



Human drivers have to process huge quantities of data simultaneously in order to drive safely. Cars driven using AI work in much the same way. The human eyes, ears, feet and hands are replaced by sensors, but the data collected sends back all the same signals: how close the car is to other vehicles, what speed is it travelling, the behaviour of other road users such as cyclists or pedestrians, etc. One European project is working on developing a system that will allow cars to switch seamlessly between their human and automated drivers, based on data from real drivers in a variety of driving conditions and cases.

What is particularly interesting about this project is its focus on the insurance industry: concerns about the ability to guarantee the safety of all road users is one of the main reasons why we do not already have fleets of driverless or self-driving cars on our roads. Therefore reassuring insurers that autonomous driving is synonymous with safer driving will be key.

AI is also being used to keep road users safe in other ways as well. A European project has looked whether adaptive cruise control, an AI-driven 'smart' system that speeds up or slows down a car as necessary to keep up with the one in front, could help reduce the risk of traffic jams and accidents.

AI will also have a major role to play in the 'smart cities' of the future in helping to control traffic flow, for example by adapting traffic light rotations in real time to meet on-the-ground traffic flow demands, or by analysing available parking spaces and updating information systems. In fact, AI will have many potential applications in cities, from helping to identify people in crowds of people based on face-recognition software – helpful in preventing terrorist attacks or finding a child lost in the crowd – to analysing air quality conditions and taking appropriate action such as limiting traffic flows or sending out automatic alerts to citizens (all applications already tested in various EU-funded projects).

Protecting us and our environment

Accelerating the shift to less polluting cars and reducing the risk of peaks in emissions caused by traffic jams is just one way in which artificial intelligence can help protect us and our environment.

Weather and climate is one particular field where we have huge quantities of both historical and real-time data, and where the artificial intelligence and computational power of supercomputers can be combined to develop extraordinarily accurate models. In a world where climate and weather systems are changing more rapidly than ever, it is more vital than ever before to be able to accurately predict the extreme weather conditions that have such a devastating effect.



A new supercomputer based in Bologna and due to come online in 2020 will focus on improving weather predictions, and it is no coincidence that Italy will be the host country for the latest generation of weather supercomputer which has been located in Reading, UK, since the late 1970s. Italy has suffered in particular from some of the most devastating environmental disasters in recent times, a great human and economic cost, and the hope is that improving our ability to predict when and where floods, fires and earthquakes will happen will help save lives.

No matter how effective the predictions become, however, it will never be possible to avoid the disasters altogether, and AI can also be used to improve our human response to crises. For example, the AI-driven SmokeBot robot can help firefighters in search and rescue missions where visibility is extremely low.



Artificial intelligence is also being used to drive the energy transition that is so vital for our society. The hills around Barcelona are home to a large number of windfarms that help power the city with sustainable energy, and MareNostrum's computing power is being put to good use in accurately mapping the best location for new turbines. Working with the Spanish energy company Iberdrola, the Barcelona Supercomputing Center is analysing geographical and weather data to predict the maximum gain in energy from each new turbine, vastly improving efficiency.

Contributing to improving efficiency and reducing emissions are also an important part of the use of AI in the agriculture sector. In an industry where much of the work is repetitive, intensive and hard, artificial intelligence can help in a number of areas. For example, smart robots already exist that can tell whether crops are ripe and then harvest them, while data from sensors in the fields can be processed using AI to automatically plant, irrigate and fertilise crops using precise amounts. The work on improving weather predictions is also important for the food and farming sector, where farmers' crops can be destroyed by one bad storm or drought.



Automated systems to reduce the need for human interaction in difficult or dangerous situations are not limited to farming. From robots that can inspect and clean sewers to aerial robotic systems that can both inspect and maintain hard-to-reach machinery – not to mention AI simulators of the conditions on the planet Mars – artificial intelligence is being used to help humans in a very wide range of conditions and industries.

Helping us learn and interact

One of the most common areas where AI is used widely is in learning – after all, most of us come across AI every day through our smartphone apps and search engines that help us advance our knowledge and find information.

Artificial intelligence is being used to turn science fiction into science fact in this area as well. Until recently, real-time translation piped directly into our ears was a convenient way of explaining why every species in the galaxy spoke the same language as Captain Kirk, but advances in machine translation, driven by AI, are making this a real-world reality, at least for human languages.

And in a world where people increasingly get their news and information online and from a very wide range of source, a European project is using artificial intelligence as the basis for systems that can separate fact from fiction automatically, addressing issues of disinformation and ‘fake news’ in today’s multilingual online environment.



Getting the information and advice we need also often means talking to companies, service suppliers or local authorities, and AI can anticipate and respond to people’s needs in a variety of different ways. One European project is working on a platform that can be embedded in any public administration’s website and improve interaction with the public through a highly sophisticated question-and-answer service, meaning people can get the answers they need from their local authorities quickly, simply and at a time that suits them.

And as the homes, workplaces, streets and spaces of the future become increasingly connected – the so-called Internet of Things – our interaction with them will become increasingly virtual and driven by artificial intelligence. We will move from the mass-production and delivery of services, such as electricity or water, to smarter, more personalised systems, bringing important resource savings. Pilot projects across Europe are already working on addressing the massive infrastructure and coordination challenges that this brings, paving the way for the smart society of the future with data and AI at its heart.



European cooperation and support

So what do all the projects and initiatives mentioned here, beyond the obvious link with machine learning or artificial intelligence, have in common? The answer is that all of them are supported to a greater or lesser extent by the European Union, and are part of Europe’s ambitious aim of building the world’s leading digital society.

The EU has been supporting artificial intelligence for many years, in no small part through its research and development programmes, FP7 and Horizon 2020. As the technology has advanced, so has the support, and AI-related projects are now funded through a myriad of different programmes, covering everything from rural development to education and skills. For the next seven-year EU budget period, which is due to start in 2021, AI and the wider digital economy will play an even more central role: a new funding programme, Digital Europe, has been proposed, with €9.2 billion potentially available to support the further development of the EU's digital single market.

AI and the supercomputing capacity that it is increasingly linked to and reliant on are set to receive the lion's share of the proposed funding – €2.5 billion and €2.7 billion respectively – underlining the particular importance that the EU is giving to this key technology with so many possibilities. But AI will also benefit from other funding opportunities within the Digital Europe programme, for example from a share of the €2 billion set aside to boosting cybersecurity and keeping data safe, from the €700 million proposed for developing digital skills or the €1.3 billion for ensuring the widespread use of digital technologies by public administrations and services.



Although this is the first time the European Commission has proposed a dedicated funding stream for digital, it will not be the only programme supporting artificial intelligence development. The Horizon Europe research programme will continue to fund much of the top-level research in this area, while several of the sector-specific funding programmes can also be potential sources of support. For example, some of the food and farming applications could be supported through Common Agricultural Policy funding.

More than just money

Important – not to say vital – as the EU's continued financial support will be to the development of AI, the EU's role goes far beyond just the money. AI has the potential to improve our lives in almost everything we do, but it will

only be able to do this if the conditions are right across the whole of our society. The EU's single market, with a common set of standards, rules and protections, is a rich breeding ground for this to happen, and Europe is uniquely placed to provide the joined-up policy-making it will need.



In our hypothetical robot of the future, AI and supercomputers are obviously the brains, fuelled by the data flowing through them; the EU plays the role of the heart, making sure the 'body' gets the resources it needs. The veins and arteries, through which the data flows, are represented by the EU-wide rules on how data can be collected, transferred and used; the antibodies that keep the data safe from harm are the EU's rules on networks and cybersecurity, and general data protection rules. The nerves are high-speed broadband and 5G, sending information back and forth at ultra-high speeds to keep the organism moving.

The EU also works to keep our robot safe and healthy. Humans need food to survive and we have developed sophisticated supply chains – from farm to fork – to help us; AI will need the same security of supply to 'feed' it with data. EU-wide pilot projects focused on the Internet of Things are already working on how to do this; data is of no use if it cannot be collected, pooled, transferred and accessed simply and easily, and the right infrastructure and framework need to be in place across the EU for this to happen.

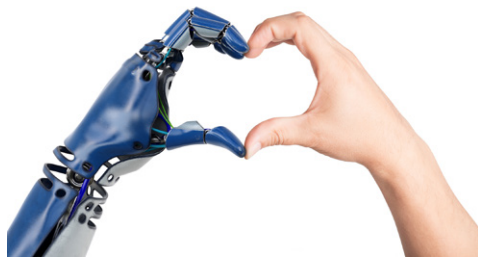
Humans have an ethical code, an understanding of what is right and wrong, and a system of laws to support it. A similar code and set of rules will be needed for AI as well. The EU is working on developing guidelines for the use of AI and updating rules on product liability, trying to find answers to such thorny questions as what the limits should be on the use of AI or who is responsible if a self-driving car is hacked and has an accident.

And it is important to recognise that an AI-centred society of the future will not necessarily be a utopia for everyone, at least not at first. If artificial intelligence can take over many tasks currently performed by humans, it is going to be very important to make sure that the humans

have the opportunity to do something else instead. The goal is not for AI to push people out of work but rather to improve the quality of their work, by allowing them to work less or in much better conditions, for example. The EU can help in numerous ways, through support to help people learn new skills for example, or through competition rules that ensure that a robot workforce cannot undercut a human one.

Ethical guidelines

Humans have an ethical code, an understanding of what is right and wrong, and a system of laws to support it. A similar code and set of rules is needed for AI as well. The EU's High Level Expert Group on AI, a team of experts from academia, industry and government, is developing a set of ethics guidelines that will ensure that trustworthy AI adheres to human rights, principles and values. The first version of the guidelines have just been published and set out how AI should adhere to basic principles: that AI should not be used to harm humans in any way; that it should not restrict human freedom (in other words, people should not be subjugated or coerced by AI-driven machines); that it should be used fairly and not to discriminate or stigmatise; that it should operate transparently (in other words, we need to know for what purpose AI is being developed and how it will be used); and that it should only be developed for the wellbeing of individuals and society as a whole, including in the most sustainable manner possible.



The guidelines also address a number of issues that need to be considered when developing AI, for example that it should not be used to identify individuals from their data without consent, that humans must always be able to override decisions taken by machines and that humans must always be aware when they are interacting with a machine. The experts also back a recent resolution by the European Parliament against the development lethal autonomous weapons systems - learning machines with cognitive skills that can potentially decide who, when and where to fight without human intervention.

And while they stress that the likelihood of AI-driven machines becoming self-conscious is extremely small

(despite what science fiction would have us believe), the experts behind the guidelines underline the need to ensure that this does not happen. The concern is not, however, that a self-conscious machine would somehow 'take over', but rather that it would effectively be an 'ethical object' and therefore subject to the same values as humans.

The guidelines also stress the importance of making sure the technology behind AI is sufficiently robust. Algorithms have to be reliable (we need to be sure the AI will do what we want it do, each time it is used) and strong enough to protect against attacks. There should also be a 'fall-back' plan in case of problems with AI (for example, AI systems that fail should ask for human intervention before continuing).

Finally, the guidelines also set out how these principles can be maintained (and the problems avoided) by following certain procedures such as making sure that privacy and safety are guaranteed from the outset and that testing and trialling is rigorous. They also stress that EU rules and regulations will be necessary to underpin the ethical guidelines, as well as an appropriate framework for accountability, the development of codes of conduct and awareness raising about the ethical implications of artificial intelligence.

Walking the same path

Every EU country is committed to supporting the development of AI in Europe and several already have national strategies on how to do so. Making the connection between these various national strategies is the core of the EU's strategy on AI: coordinating and strengthening the work of the various AI research centres across Europe; supporting the development of AI applications across every sector of society; and pooling resources at the EU level with access for everyone.

For all its ambition, the EU is still lagging behind other parts of the world when it comes to investing in AI. But this is changing. The European Commission has already agreed to increase EU research funding for AI to €1.5 billion between now and 2020; expected investments from Member States and from the private sector should bring this figure closer to €20 billion for the same period. If the Digital Europe funding programme is agreed, EU support for AI from 2021-2027 will be €7 billion (€1 billion per year), and the aim is to combine this with national funding and investment by the private sector to reach around €20 billion a year.

Now the Commission is publishing its coordinated plan on artificial intelligence, its proposals on where to target these investments and how best to coordinate the development of AI across the EU while keeping it squarely focused on human needs.

Each EU country will have to put in place a national AI strategy – and commit funding to support it – by mid-2019; the Commission and Member States will work together with academia and industry to develop a common research and innovation agenda for AI, and a new fund to support European AI start-ups will be developed, with €100 million available by 2020. Networks of European AI research excellence centres will be created to improve cooperation between the best research teams in Europe and to help develop world-leading AI testing facilities. Private and public sector access to AI applications and technologies will be improved using the existing EU-wide network of Digital Innovation Hubs, which already act as the link between academia and research and the wider commercial market. Making sure Europe has the skills and the expertise necessary to support this vision is also a key part of the proposals, with a focus on developing and retaining more home-grown talent in AI, and on retraining.



Since data is the lifeblood of AI, there is a particular focus on improving the collection of and access to high quality datasets across the EU and in every domain. For public data, for example, this means identifying which data sets can be made available (anything from public transport movements to public utility information), making sure they are open and accessible to everyone and providing the space to store them safely on the cloud. For health data such as patient information, medical records and diagnostic results, meanwhile, the aim is to develop a common database of health images.

In the longer term, the EU will invest jointly with Member States and the private sector in the creation of a common European Data Space that makes data easily available for re-use to innovators, businesses and public sector. More immediately, an AI-on-demand platform will be created to pool knowledge and expertise on AI, including algorithms and tools, to help expand access to the existing body of work on AI in the EU. The proposals also reaffirm the EU's commitment to developing ethical guidelines for AI and encouraging the take up of AI by the public sector.

While the action plan focuses squarely on AI, the EU has also committed in parallel to investing heavily in the supercomputing power needed to move AI to the next level. The EuroHPC (for High Performance Computing) joint undertaking is designed to develop a pan-European supercomputing infrastructure and supporting research and innovation in the field. The simple fact of the matter is that global supercomputing is dominated by the US and China, and very few of the EU's installations can currently rival their counterparts in these countries. EuroHPC's aim is to create at least two supercomputers that will be in the top five at the global level by 2020, with an investment of at least €1 billion, and three to four others that would be in the top 25. There are currently seven European supercomputers in the global top 25, including all those in the five host countries of the Partnership for Advanced Computing in Europe (PRACE) which represents the best that Europe has to offer in supercomputing. These include the supercomputers in Barcelona and Bologna, the JUWELS supercomputer in Jülich (plus two others in Germany) and the Tera 1000-2 supercomputer in Paris, as well as the Pix Daint in Zurich, Switzerland. Together, these five hosting members and 20 other country members are working on more than 600 scientific projects using European high performance computing, including many related to AI.

Putting the human back in artificial intelligence

Artificial intelligence is a tool – albeit a highly sophisticated one – that can help improve the quality of life for everyone, and as such something to be excited about rather than to fear.

But like any tool, artificial intelligence still needs human interaction to function, and it is this human focus on AI that underpins the EU's approach. Developing artificial intelligence is not an end in its own right - it has to serve the greater good of society. That AI can do this is undeniable; it is now up to Europe to make sure the right conditions are in place to make it happen. ■

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EU-supported projects mentioned

3rdhandrobot.eu - robotic third hand

https://cordis.europa.eu/project/rcn/110160_en.html

RoboHow - robots that learn <http://www.robohow.eu>

Robdream <http://robdream.eu> & **Dream** <http://www.robotsthatdream.eu> - robots that dream

MURAB - MRI and ultrasound assisted biopsy

<https://www.murabproject.eu>

SMARTsurg - remote surgery

<http://www.smartsurg-project.eu>

SMuFIN - genome identification <http://cg.bsc.es/smufin>

AlyaRed - computational heart

<https://www.bsc.es/news/bsc-news/alya-red-computational-heart>

KConnect - medical database <http://www.kconnect.eu>

VI-DAS - human and automated driving <http://vi-das.eu/>

Optimum - mobility and traffic flow

<http://www.optimumproject.eu/>

TRAMAN21 - traffic management using adaptive

cruise control <http://www.traman21.tuc.gr/>

SmokeBot - robot for low-visibility sites

<http://130.243.105.49/Research/mro/smokebot/>

SEDAR - wind farm production capacity simulation

<https://www.iberdrola.com/top-stories/iberdrola-shares-with-you/installation-wind-turbines>

VineRobot - remote sensing of grape ripeness

https://cordis.europa.eu/news/rcn/128526_en.html

ERMES - crop management

https://cordis.europa.eu/project/rcn/188830_en.html

ECHORD++ - sewer inspections

<http://echord.eu/pdti/pdti-urban-robotics-sewer-inspection/>

Aeroarms - aerial inspection and maintenance

<https://aeroarms-project.eu/>

iMars - visualising the Red Planet

https://cordis.europa.eu/project/rcn/188855_en.html

FANDANGO - fake news discovery <https://fandango-project.eu/>

Simpatico - public administration interface

<https://www.simpatico-project.eu/>

Internet of Things Large Scale Pilots

<https://european-iot-pilots.eu/>,

including **MONICA** <https://www.monica-project.eu/> on security at major events

and **Synchronicity** <http://synchronicity-iot.eu/>

on the cities of the future

EuroHPC - supercomputer joint undertaking

<https://eurohpc-ju.europa.eu/index.html>

PRACE - supercomputer partnership <http://www.prace-ri.eu/>

