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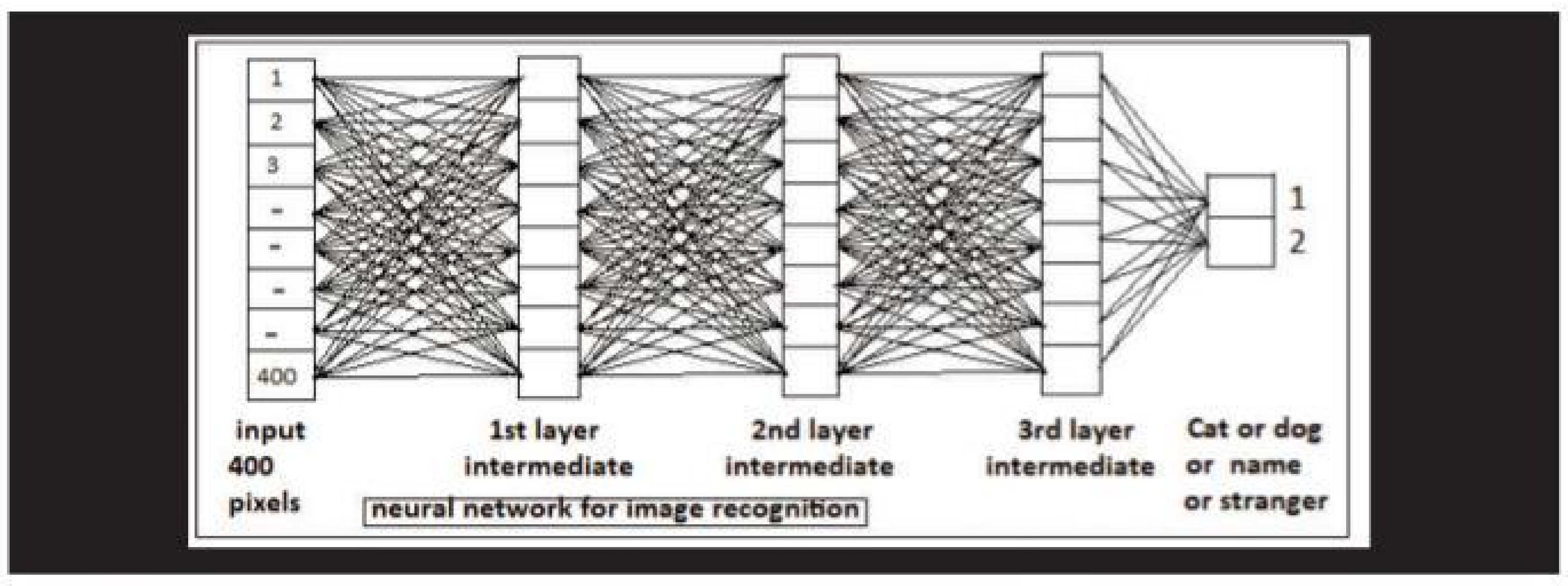
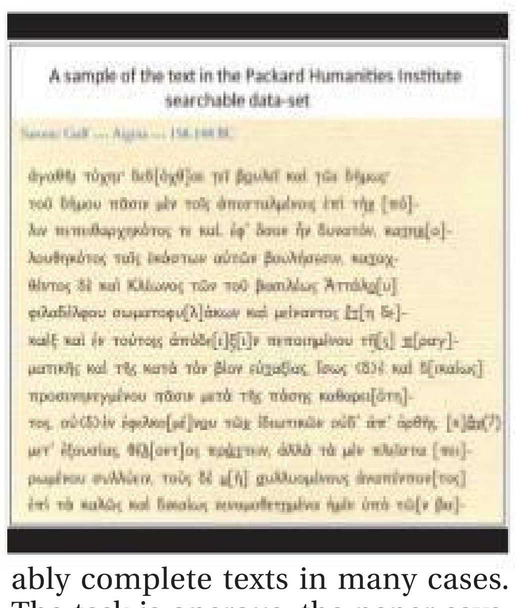
AI, Greek texts & Big Data




Damaged Greek epigraphy cr: Univ of Oxford



Machine learning helps fill the gaps in fragments that remain of ancient texts

S ANANTHANARAYANAN

The science of archeology uncovers utensils, dwellings, large structures and the layout of ancient settlements. And where there are records of written matter, the ancient civilisations come “literally” to life.

Yannis Assael, Thea Sommerschield, Brendan Shillingford, Mahyar Bordbar, John Pavlopoulos, Marita Chatzipanagiotou, Ion Androutsopoulos, Jonathan Prag and Nando de Freitas, from Ca' Foscari University of Venice, Harvard University, Athens University of Economics and Business, University of Oxford and Deep Mind, an Artificial Intelligence, or AI, company based in London, describe in the journal, *Nature*, how AI was used, and could be used, to help recover Greek texts from damaged and obscured remains of ancient writings in Greek.

Written records in the form of papyrus or palm leaf are of comparatively recent periods. The more ancient, which have survived, are those that were carved into stone, engraved in metal, or in pottery, as in cuneiform.

And many of these records, naturally, are the worse for wear and age. Letters are hence damaged, or whole words and phrases are missing. Many records are not in the places where they were created. And, as epigraphy, as records on durable materials are known, do not contain organic matter, they cannot be carbon-dated to know their antiquity.

Nevertheless, scholars of ancient history, experts of the languages, and scientists, including mathematicians, have been able to work out reasonably complete texts in many cases. The task is onerous, the paper says, and “involves highly complex, time-consuming and specialised workflows”. For instance, to guess what missing matter could be, scholars use other texts of similar construction or context. Such portions of texts were initially what was within the researchers' knowledge, and more recently, as found by computer aided “searches”. These processes, however, were slow and unreliable, and they could miss out the appropriate leads or confuse the search, the paper says. And, as the purpose of reconstruction is to build historical narrative, it is important to know the place where the record was created, as well as the date, as accurately as possible. If the record had been moved, its place of origin needs to be deduced from other evidence, such as letter forms or the dialect. And while the idiom or context can fix the date of production, it is not without uncertainty.

In the paper now reported, the authors substitute a “deep neural network”, a computer based, mass-data processing technique, to take the place of the usual methods. Neural networks are computer processes that mimic what we believe the animal brain does, to derive meaning from the data that it receives from the senses. In the case of the computer, the programmer creates a fast and accurate mechanism to carry out calculations or sort data. The animal brain, however, has no “programme” to follow, it needs to work out its own process. A form of “learning”, based only on the data that comes in, and by refining the process, based on results.

Discovering the “rule” that is hidden inside data, typically involves dealing with a very large data-set, repeatedly, through a powerful computing arrangement. While a large data-set is there, when an infant begins to receive signals of the environment through her senses, the animal brain has a vast array of computing units in the form of nerve cells. Which accounts for the unequalled perception and movement that organisms are capable of. The neural network of computers follows this method of the brain, using the very high capacity that modern computers have, to create systems that automate learning the ways of decision making, and processes of interpreting data.

An illustrative example would be image recognition. The human, and often other animal capacity to recognise people is phenomenal. At the same time, there is no method to programme a computer to make people apart, with reasonable accuracy. But a neural network can “learn” how to do it. For example, a network that can tell pictures of dogs as different from pictures of cats, is exposed to a vast data-set of labelled photographs of dogs and cats, labelled, in the sense that each picture is marked as a dog or a cat.

When presented with a picture, the network typically breaks the picture into smaller frames, and then acquires features, like the brightness and colours of the frames, and evaluates a finding, based on a set of multipliers of the different values. Every time the finding differs from the label, the network makes changes of the multipliers, to bring the finding closer to the label. After thousands of iterations, and trials with even millions of pictures, the system gets pretty good at identifying dogs and cats. And an extension is to consider a set of feature values from a set of pictures of each person, to identify the persons themselves.

“Training” the system, of course, calls for a very large, labelled data-set. And repositories of such images are available, sometimes to buy. Systems that are tuned to criteria, like speed, or accuracy, are then built, and trained using public data-sets. The system can be used to help a mobile phone recognise its rightful user, for instance, or an entry point to recognise authorised visitors.

A variation of the process is to train the system to predict a missing word in a sentence. Here, words that follow, or precede, a set of other words, are located from a “dictionary” of possible words, based on the pattern discovered, or learnt, from a massive data-set of examples. In the case of modern languages, there are ample sources of digitised text to help “train” the system. The way word processors can “auto-complete” words or sentences is an example of such a system in action.

Ancient Greek epigraphy

This is not so with ancient languages not in current use. In the case of Greek epigraphy, fortunately, there is an extensive collection of text from ancient Greece, complete and annotated by scholars of Cornel and Ohio State Universities, supported by the Packard Humanities Institute, in California. The data-set has been created to assist historians, consists of the transcribed text of 178,551 inscriptions, the paper says. And the data-set is “searchable”, so that relevant portions can be readily located. Then, it contains information of the location as well as the precise date of creation, as worked out by scholars.

The team hence processed this information into a machine-readable form and fed a set of 78,608 inscriptions to a neural network system, named Ithaca after the island in Homer's *Iliad*. The network is called a “deep neural network”, because it consists of several layers, with as many sets of multipliers, and each layer processing the results of the previous layer.

The system was created to work collaboratively with human experts. In place of providing single predictions, the system outputs a set of 20 possible predictions, ranked by probability. The prediction is then paired with the contextual knowledge of human experts. And the features of the inputs, which contributed most to the predictions are identified.

Along with identifying text, Ithaca also pinpoints location again with a ranked list of possibilities out of a range of 84 regions. And then, the dates, the dates between 800 BCE and 800 ADS are put into buckets of 10 years each.

“Historians may now use Ithaca's interpretability-augmenting aids to examine these predictions further and bring more clarity to Athenian history,” the paper says.

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PLUS POINTS

New tortoise species

A new species of giant tortoise has been discovered in the Galapagos Islands after scientists found that animals living on one side of the archipelago had not previously been recorded.

The study, published last week in the journal *Heredity*, assessed the deoxyribonucleic acid, or DNA, of tortoise bone museum samples collected from the highlands of the San Cristóbal island over a century ago and compared them with those of giant tortoises currently living on the island. Researchers, including those from the University of Newcastle in the United Kingdom and Yale University in the United States, found that the DNA from the museum samples did not match that of the tortoises inhabiting the island now.

Until now, scientists thought the tortoises living on San Cristóbal belonged to a single species, *Chelonoidis chathamensis*, described on the basis of bones and shells collected from a cave during a 1906 California Academy of Sciences expedition to the South-western highlands of the island. But the new findings suggested approximately 8,000 tortoises currently living on San Cristóbal may not be rightly called *C. chathamensis* as they are from a separate lineage with no formal description or scientific name yet.

“The species of giant tortoise that inhabits San Cristóbal Island, until now scientifically known as *Chelonoidis chathamensis*, genetically corresponds to a different species, which was believed to be extinct since the beginning of the 20th century,” Ecuador's environment ministry said in a tweet.

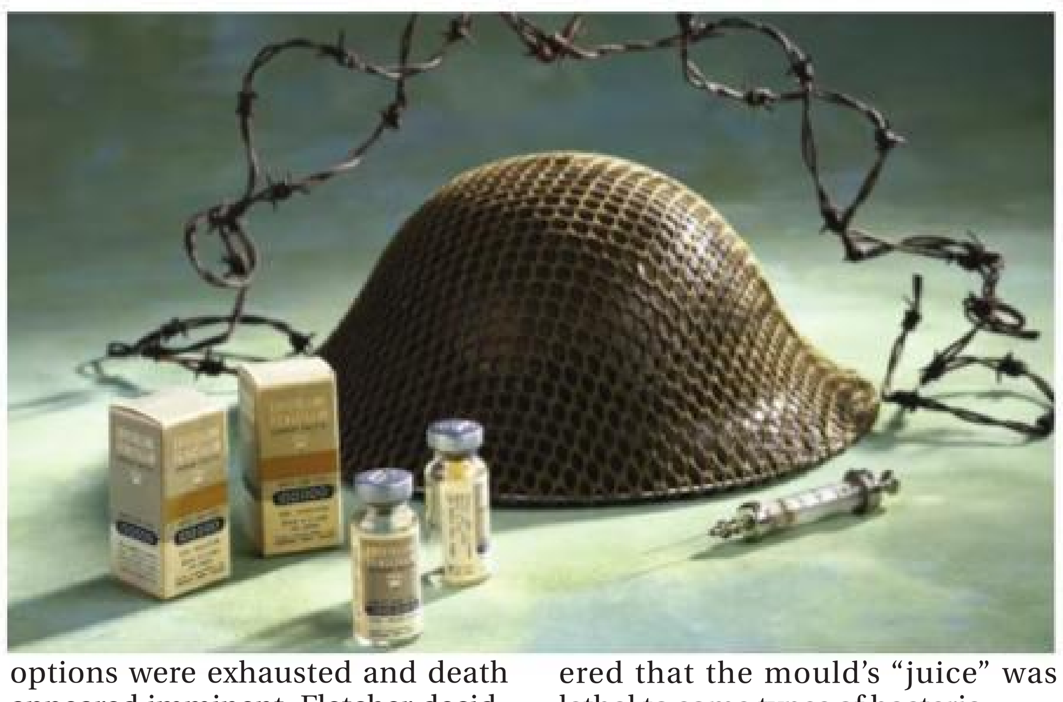
Scientists from American non-profit Galapagos Conservancy, who were also part of the study, said the giant tortoise species, whose bones were recovered in 1906, “is almost certainly extinct”. They said the island had two different lineages of tortoises living together one in the highlands and another in the lowlands with each likely having different nesting areas until the highlands species were wiped out in the middle of the 20th century.

Researchers hope to recover more DNA from the extinct species to better inform the classification of the San Cristóbal tortoises and to understand how the current living species is related to the extinct one.

The independent

Guns, not roses


Albert Alexander in uniform




Alexander Fleming

Here's the true story of the first patient to be administered penicillin

BILL SULLIVAN

Albert Alexander was dying. World War II was raging, and this police officer of the county of Oxford, England, had developed a severe case of sepsis after a cut on his face became badly infected. His blood was now teeming with deadly bacteria.

According to his physician, Charles Fletcher, Alexander was in tremendous pain, “desperately and pathetically ill”. The bacterial infection was eating him alive; he'd already lost one eye and had oozing abscesses all over his face and in his lungs.

Since all known treatment options were exhausted and death appeared imminent, Fletcher decided that Alexander was the perfect candidate to try a new, experimental therapy. On 12 February 1941, Alexander became the first known person to be treated with penicillin. Within days he began to make a stunning recovery.

I am a professor of pharmacology, and Alexander's story is the prelude to my yearly lecture on antibiotics. Like many other microbiology instructors, I'd always told students that Alexander's septicaemia arose after he scratched his cheek on a thorn while pruning rosebushes. This popular account dominates the scientific literature as well as recent articles and books.

The problem is, while descriptions of the miraculous effect of penicillin in this case are accurate, the details of Alexander's injury were muddled, likely by wartime propaganda.

Breaking the mould

The promise of penicillin as an antibiotic was first noted in 1928, when microbiologist Alexander Fleming noticed something funny in his petri dishes at St Mary's Hospital in London. Fleming's cultures of staphylococcal bacteria did not grow well on plates contaminated with a penicillium mould. Fleming discovered that the mould's “juice” was lethal to some types of bacteria.

A decade later, a team of scientists led by Howard Florey at Oxford University began the arduous task of purifying the active substance from the “mould juice” and formally testing its antimicrobial properties. In August 1940, Florey and his colleagues published their striking findings that purified penicillin safely wiped out numerous bacterial infections in mice.

Florey then sought Fletcher's help to try penicillin in a human patient. That patient would be Alexander, whose death seemed inevitable otherwise. As Fletcher stated, “There was all to gain for him in a trial of penicillin and nothing to lose.”

At the time, purified penicillin was extremely scarce, since the mould was slow to grow and yielded precious little of the drug. Despite recycling unprocessed penicillin from Alexander's urine, there just wasn't enough available to finish off the infection once and for all. After 10 days of improvement, Alexander gradually relapsed. He died on 15 March 1941, at the age of 43.

Despite the tragic outcome, Alexander's case turbocharged interest in penicillin research. As Fletcher observed, “There was no doubt about the temporary clinical improvement, and, most importantly, there had been no sort of toxic effect during the five days of continuous administration of penicillin.”

Almost exactly a year later, on 14 March 1942, doctors in Connecticut administered the antibiotic to a woman named Anne Miller who was deathly ill with streptococcal septicaemia. She made a full recovery and became the first patient cured with penicillin. Mass production of penicillin became a top priority of the United States War Department, second only to the Manhattan Project. It is widely believed that penicillin helped the Allies during World War II, preventing wound infections and helping soldiers diagnosed with gonorrhoea to return to the battlefield.

The rosebush tale has been a thorn in their sides

Albert Alexander has earned a place in history as the first known person to be treated with penicillin for a clinical condition. Almost as famous as his name is the purported cause of death sepsis due to a scratch from rosebushes.

An alternative explanation, however, was revealed in a 2010 interview with Eric Sidebottom, a historian and author of *Oxford Medicine: A Walk Through Nine Centuries*. He claimed that Alexander was injured when his police station was hit during a German bombing raid on 30 November 1940. Shrapnel from this attack caused the facial lacerations that led to Alexander's fatal blood poisoning, he said.

Alexander's daughter, Sheila LeBlanc, who moved to California and became an artist, confirmed Sidebottom's account in a 2012 interview with a local newspaper. She also revealed the grim consequences Alexander's death had on his family. Since they'd lived in a house provided by the village, for the village constable, his death forced them to move out. LeBlanc, who was seven at the time, and her older brother were sent to an orphanage, since their mother had to find work.

Michael Barrett, a professor of biochemical parasitology at the University of Glasgow, also spoke to LeBlanc about the cause of Alexander's injury. Writing in 2018, Barrett stated that while LeBlanc recalled that the constable's house did have a beautiful rose garden, her father's fatal cut was sustained during the German blitz.

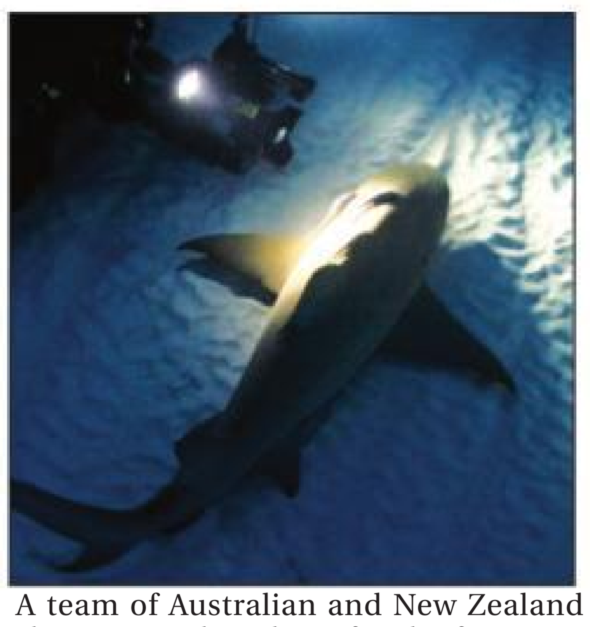
In February this year, I contacted Alexander's granddaughter, Linda Willason, who is also an artist in California, to help set the record straight. Willason validated the shrapnel account and suggested that the rosebush story was “a bit of wartime propaganda”. By downplaying bombing injuries, the government likely hoped to maintain the public's stiff upper lip.

While the nature of Alexander's injury may seem a trivial detail, correcting the historical record is important. Alexander died in the line of duty, and the apocryphal rosebush story obscures his honourable actions. His descendants are hopeful the true account of his injury will now eclipse the false one.

In 2021, a plaque commemorating Alexander was installed in Newbury that reads, “On war support duty in Southampton on 30th November 1940, Albert was injured in an air raid. Contracting staphylococcal and streptococcal septicaemia, he was transferred to the Radcliffe Infirmary in Oxford, where he was selected for the first clinical application of penicillin. His place in the history of antibiotics is secure.”

The writer is professor of pharmacology and toxicology, Indiana University School of Medicine, United States. This article first appeared on www.theconversation.com

Eyes-open sleep



A team of Australian and New Zealand sleep researchers have for the first time proven that sharks need a good night's rest even with their eyes wide open.

The research, published in *Biology Letters* last week, was able to monitor the metabolic rates and changing posture of sharks in a controlled lab environment, giving the first solid evidence for sleep in this 450-million-year-old animal.

Lead author on the study, Michael Kelly from La Trobe University in Melbourne, Australia, said that all previous research of sleep in sharks had been based on behavioural observations, and this was the first time that concrete, physiological evidence had been drawn. Since 2018, the team of researchers has been conducting studies in Leigh, a small fishing village on the northern tip of New Zealand's North Island.

The draughtsboard sharks used in the study were caught off the coast and brought back to a lab and housed in a respirometry chamber, which measures oxygen levels in the water. “And this gives you an indication as to what's going on with the metabolism. And what we were looking at is what levels their metabolism is at when they're swimming, compared to inactive,” Kelly said.

The researchers soon noticed that after about five minutes of rest, the metabolic rate of the shark dropped, and its posture made a clear shift. “They go from sort of sitting up on their pectoral fins with their heads up on the ground, to just lying completely flat,” Kelly said, adding that this behaviour correlated directly with a drop in metabolism.

The straits times/ANN