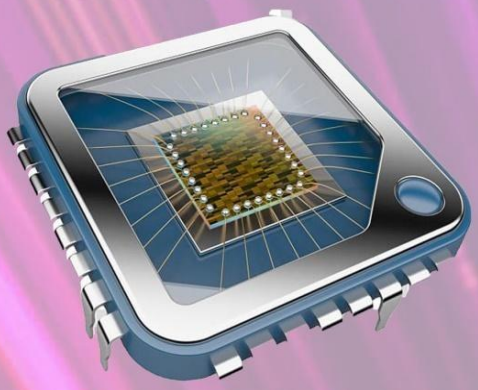
INFOLINE

Volume XI Issue 1 July 2020



DEPARTMENT OF COMPUTER TECHNOLOGY AND INFORMATION TECHNOLOGY

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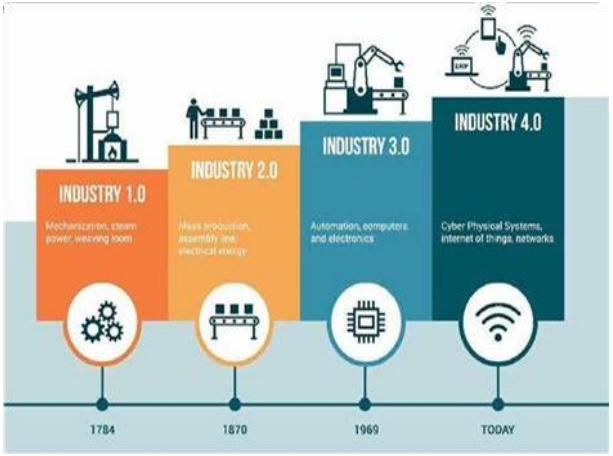
INDUSTRY 4.0-A FOURTH INDUSTRIAL REVOLUTION

Currently, industry represents the part of the economy that carries out the production of materials and goods which are highly mechanized and automatized. Nowadays, the industrial production has reached the edge of a new industrial revolution and the factory of the future has been pictured. Industry 4.0 is a promising approach based on integration of the business and manufacturing processes as well as integration of all actors in the company's value chain. It is a strategic initiative recently introduced by the German government.

The main goal of the initiative is transformation of industrial manufacturing through digitalization and exploitation of potentials of new technologies. An Industry 4.0 production system is thus flexible and enables individualized and customized products. It refers to a new phase in the Industrial Revolution that focuses heavily on interconnectivity, automation, machine learning, and real-time data. Industry 4.0 also some- times referred to as IIoT or smart manufacturing, marries physical production and operations with smart digital technology, machine learning and big data to create a more holistic and better connected ecosystem for companies that focus on manufacturing and supply chain management.

The core of this Industry 4.0 is Internet of things which allows connection of machines, products, systems and people. It can be defined as the embedding of smart products into digital and physical processes. In short, the term Industry 4.0 appeared published for the first time in November 2011 by the German government that resulted from an initiative regarding high-tech strategy for 2020 and since then this concept is used across Europe. One of the key features of Industry 4.0 is the creation of highly automated industries through human-machine interaction.

Technological progress has created several advantages for business world; new concepts such as digitalization, Internet of Things (IoT) and Cyber Physical Systems (CPS) have gained importance across industries including manufacturing. These terms are used in defining the Fourth Industrial Revolution (Industry 4.0). Industry 4.0 triggers a staggering effect by transforming the manufacturing and production processes in industries. In other words, Industry 4.0 will play a significant role in transforming traditional companies into Smart Factories with the help of Internet of Things (IoT) and Cyber Physical Systems (CPS).



The development of integrated processes and human machine interaction stimulate complexity and agility. With the help of Industry 4.0, industries will gain operational efficiency both in time, cost and also productivity. Building the infrastructure of IoT offers shared platforms via cloud systems between partners in Supply Chains. The increase in usage of computerized systems after the 3rd Revolution, Industry 4.0 deals with creating more digitized systems and network integration via smart systems. Through Industry 4.0, smart systems would enable the replacement of the human-being in certain tasks and ease the working environment.

The most challenging aspects for the organizations that wish to adopt this new approach are touch skills and qualifications of their workers concerning e.g. problem-solving skills, failure analysis, the ability to deal with constant changes and completely new tasks. Indeed, they should be able to trial with specific Industry 4.0 technologies with new complexity tasks: the collection, processing and visualization of manufacturing process data. Other challenges and issues of firms are related to innovation, technological components, digital transformation advancements and the rising interconnectivity developments which play an important role in every organization.

Benefits of Industry 4.0

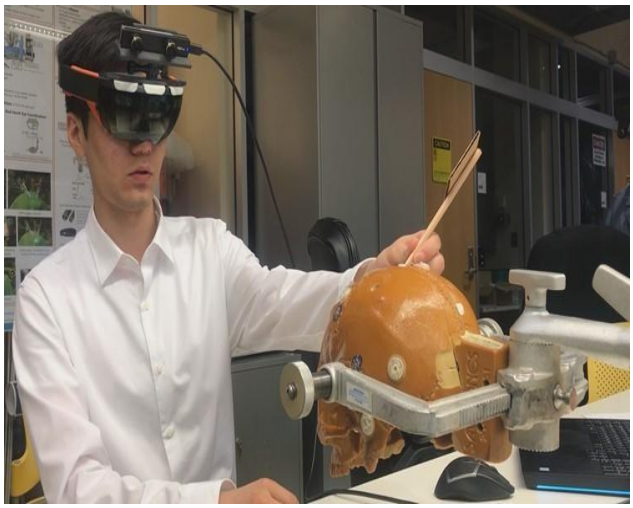
Industry 4.0 provides numerous benefits, for example the reduction of labour costs, the simplification of business processes and the reduction of inventory inaccuracies, as well as more transparency in logistics processes. The benefits of Industry 4.0 include improved productivity and efficiency, better flexibility and agility, and increased profitability. Industry 4.0 also improves the customer experience. With fewer people and more automation, companies can make decisions more rapidly and keep efficiency high. Automation also tends to keep quality high, and that's an area that further boosts efficiency. While Industry 4.0 will require initial investments, once the intelligence is built into products and processes, the costs will plummet. Fewer quality problems lead to less material waste, lower personnel and operating costs. The speed and ability to handle such a high mix seamlessly will also lower costs.

K.Sureshkumar

III B.Sc. (Computer Technology)

VR PROGRAM BUILT TO ASSIST IN BRAIN SURGERY

Virtual Reality platform built by a research team to help with brain surgery. Video games and brain surgery are two things not often used in the same sentence. A team of researchers at Johns Hopkins University is creating something to help surgeons perform better. The platform is based on augmented reality and involves taking a virtual reality headset and pairing it for use with image-guided procedures.



"It has cameras and it has visualizations," said Peter Kazanzides, a research professor in the department of computer science at Johns Hopkins. "The system actually detects where the patient is then overlay medical information on the patient, much the same way a GPS would work to tell you where your car is."

To be clear, it doesn't all of a sudden make brain surgery easier. The AR provides the opportunity to practice. It can highlight certain parts of the brain, showing doctors what they're looking at, and even put other items into the scene. However, there are a number of challenges. According to Ehsan Azimi, the leader of the team effort, one of those difficulties is accurately overlaying virtual objects on top of the real scene. "It is mixed reality, so that involves virtual content and real content… and the very key component of that is to correctly overlay those virtual contents," Azimi said.

"The biggest struggle is that it's much harder than it seems," Kazanzides adds. "I can take an AR headset, put it on, and I can walk the surface of the moon so it seems like other things should be easy, but it's actually much more difficult to overlay very precisely on a patient the location of some internal anatomy." Azimi who is also a PhD candidate in computer science at the Johns Hopkins Whiting School of Engineering, points out that the team wants this technology to help patients and surgeons. Right now, the project is being used to target ventriculostomy.

M.Bhavan

II B.Sc. (Computer Technology)

INTELLIGENT CAMERAS ENHANCE HUMAN PERCEPTION

Intelligent cameras are the next milestone in image and video processing. A team of researchers at the Chair of Multimedia Communications and Signal Processing at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) has developed an intelligent camera that achieves not only high spatial and temporal but also spectral resolution. The camera has a wide range of applications that can improve environmental protection and resource conservation measures as well as autonomous driving or modern agriculture. The findings of the research have been published as an open access publication.

'Research up to now has mainly focused on increasing spatial and temporal resolution, which means the number of megapixels or images per second,' explains lecturer Dr. Jürgen Seiler. Spectral resolution the wavelength and thus the perception of colours has largely been adjusted to match human sight during the development of cameras which merely corresponds to measuring the colours red, green, and blue. However, much more information is hidden in the light spectrum that can be used for a wide range of tasks. For example, we know that some animals use additional light spectra for hunting and searching for food.

Three resolutions in one camera

Seiler who is an electrical engineer has therefore developed a high-resolution multi-spectral camera that enhances human perception with his team at the Chair of Multimedia Communications and Signal Processing (LMS) led by Prof. Dr. Kaup at FAU. It combines all three resolutions spatial, temporal and spectral in a cost-efficient solution. 'Up to now, there were only extremely expensive and complex methods for measuring the ultraviolet or infrared ranges of light or individual spectral bands for special industrial applications,' says Seiler. 'We looked for a cost-efficient model and we were able to develop a very cost-effective multi-spectral camera.'

The researchers connected several inexpensive standard cameras with various spectral filters to form a multi-spectral camera array. 'We then calculated an image in order to combine the various spectral information from each sensor,' explains Nils Genser, research associate at LMS. 'This new concept enables us

to precisely determine the materials of each object captured using just one single image.'

At the same time, the new camera is greatly superior to existing systems in terms of its spatial, temporal and spectral resolution. As the surroundings are recorded by several 'eyes' as is the case with human sight, the system also provides a precise indication of depth. This means that the system not only precisely determines the colour and certain material properties of objects it captures, but also the distance between them and the camera.

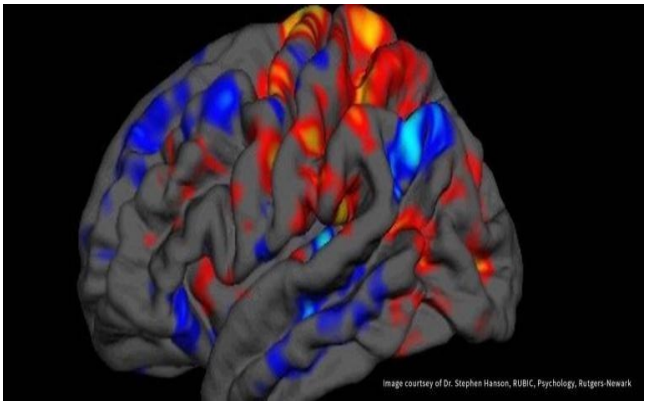
Ideal for autonomous driving and environmental technology

Autonomous driving is a potential application for these new intelligent cameras. 'A whole range of solutions to various problems has now opened up thanks to our new technology,' says Seiler. 'In the infrared range, for example, we can differentiate between real people and signposts using the thermal signature. For night driving, we can detect animals crossing the road with sufficient warning.' The high-resolution multi-spectral cameras could also be used for protecting the environment and conserving resources. 'Several plastics differ significantly from each other in various ranges of the spectrum, which is something the new intelligent camera can reliably detect,' Genser emphasises. 'Large amounts of plastics are simply burned instead of separated for recycling as they have a similar appearance. We can now separate them reliably.'

N.R Sharmila

II B.Sc. (Information Technology)

GRAPHENE-BASED MEMORY RESISTORS SHOW PROMISE FOR BRAIN-BASED COMPUTING



As progress in traditional computing slows, new forms of computing are coming to the forefront. At Penn State, a team of engineers is attempting to pioneer a type of computing that mimics the efficiency of the brain's neural networks while exploiting the brain's analog nature. Modern computing is digital, made up of two states, on-off or one and zero. An analog computer, like the brain, has many possible states. It is the difference between flipping a light switch on or off and turning a dimmer switch to varying amounts of lighting.

Neuromorphic or brain-inspired computing has been studied for more than 40 years, according to Saptarshi Das, the team leader and Penn State assistant professor of engineering science and mechanics. What's new is that as the limits of digital computing have been reached, the need for high-speed image processing, for instance for self-driving cars, has grown. The rise of big data which requires types of pattern recognition for which the brain architecture is particularly well suited, is another driver in the pursuit of neuromorphic computing.

The shuttling of this data from memory to logic and back again takes a lot of energy and slows the speed of computing. In addition, this computer architecture requires a lot of space. If the computation and memory storage could be located in the same space, this bottleneck could be eliminated. "We are creating artificial neural networks, which seek to emulate the energy and area efficiencies of the brain," explained Thomas Shranghamer, a doctoral student in the Das group and first author on a paper recently published in Nature Communications. "The brain is so compact it can fit on top of your shoulders, whereas a modern supercomputer takes up a space the size of two or three tennis courts."

Like synapses connecting the neurons in the brain that can be reconfigured, the artificial neural networks the team is building can be reconfigured by applying a brief electric field to a sheet of graphene, the one-atomic-thick layer of carbon atoms. In this work they show at least 16 possible memory states, as opposed to the two in most oxide-based memristors, or memory resistors. The team thinks that ramping up this technology to a commercial scale is feasible. With many of the largest semiconductor companies actively pursuing neuromorphic computing. The Army Research Office supported this work. The team has filed for a patent on this invention.

S.Haritha

III B.Sc. (Information Technology)

WORLD'S SMALLEST ATOM-MEMORY UNIT CREATED

Faster, smaller, smarter and more energy-efficient chips for everything from consumer electronics to big data to brain-inspired computing could soon be on the way after engineers at The University of Texas at Austin created the smallest memory device yet. And in the process, they figured out the physics dynamic that unlocks dense memory storage capabilities for these tiny devices. The research published recently in Nature Nanotechnology builds on a discovery from two years ago, when the researchers created what was then the thinnest memory storage device. In this new work, the researchers reduced the size even further, shrinking the cross section area down to just a single square nanometer.

Getting a handle on the physics that pack dense memory storage capability into these devices enabled the ability to make them much smaller. Defects, or holes in the material, provide the key to unlocking the high-density memory storage capability. "When a single additional metal atom goes into that nanoscale hole and fills it, it confers some of its conductivity into the material, and this leads to a change or memory effect," said Deji Akinwande, Professor in the Department of Electrical and Computer Engineering.

Though they used molybdenum disulfide also known as MoS2 as the primary nanomaterial in their study, the researchers think the discovery could apply to hundreds of related atomically thin materials. The race to make smaller chips and components is all about power and convenience. With smaller processors, you can make more compact computers and phones. But shrinking down chips also decreases their energy demands and increases capacity, which means faster, smarter devices that take less power to operate.

The results obtained in this work pave the way for developing future generation applications that are of interest to the Department of Defense such as ultra-dense storage, neuromorphic computing systems, radio-frequency communication systems and more, said Pani Varanasi, Program Manager for the U.S. Army Research Office which funded the research. The original device dubbed "atomristor" by the research team was at the time the thinnest memory storage device ever recorded, with a single atomic layer of thickness. But shrinking a memory device is not just about making it thinner but also building it with a smaller cross-sectional area.

"The scientific holy grail for scaling is going down to a level where a single atom controls the memory function, and this is what we accomplished in the new study," Akinwande said. Akinwande's device falls under the category of memristors, a popular area of memory research, centered around electrical components with the ability to modify resistance between its two terminals without a need for a third terminal in the middle known as the gate. That means they can be smaller than today's memory devices and boast more storage capacity.

R.Shobika

II B.Sc. (Computer Technology)

COMPUTER SCIENTISTS LAUNCH COUNTEROFFENSIVE AGAINST VIDEO GAME CHEATERS

University of Texas at Dallas computer scientists have devised a new weapon against video game players who cheat. The researchers developed their approach for detecting cheaters using the popular first-person shooter game Counter-Strike. But the mechanism can work for any massively multiplayer online (MMO) game that sends data traffic to a central server.

Counter-Strike is a series of games in which players work in teams to counter terrorists by securing plant locations, defusing bombs and rescuing hostages. Players can earn in-game currency to buy more powerful weapons, which is a key to success. Various software cheats for the game are available online. "Sometimes when you're playing against players who use cheats you can tell, but sometimes it may not be evident," said Md Shihabul Islam, a UT Dallas computer science doctoral student in the Erik Jonsson School of Engineering and Computer Science and lead author of the study, who plays Counter-Strike for fun. "It's not fair to the other players."

In addition to fair play, cheating also can have an economic impact when dissatisfied players leave to play other games, Islam said. Cheating incidents also can have serious consequences in esports, a fast-growing industry with annual revenues close to $1 billion. Cheating can result in sanctions against teams and players, including disqualification, forfeiture of prize money and a ban on future participation, according to the Esports Integrity Commission based in the United Kingdom.

Detecting cheating in MMO games can be challenging because the data that goes from a player's computer to the game server is encrypted. Previous research has relied on decrypted game logs to detect cheating after the fact. The UT Dallas researchers' approach eliminates the need for decrypted data and instead analyzes encrypted data traffic to and from the server in real time. "Players who cheat send traffic in a different way," said Dr. Latifur Khan, an author of the study, professor of computer science and director of the Big Data Analytics and Management Lab at UT Dallas. "We're trying to capture those characteristics."

For the study, 20 students in the UT Dallas class Cyber Security Essentials for Practitioners downloaded Counter-Strike and three software cheats: an aimbot, which automatically targets an opponent; a speed

hack which allows the player to move faster; and a wallhack which makes walls transparent so players can easily see their opponent. The researchers set up a server dedicated to the project so the students' activity would not disrupt other online players. The researchers analyzed game traffic to and from the dedicated server. Data travels in packets, or bundles, of information. The packets can be different sizes, depending on the contents. Researchers analyzed features, including the number of incoming and outgoing packets, their size, the time they were transmitted, their direction and the number of packets in a burst which is a group of consecutive packets.

By monitoring the data traffic from the student players, researchers identified patterns that indicated cheating. They then used that information to train a machine-learning model, a form of artificial intelligence, to predict cheating based on patterns and features in the game data. The researchers adjusted their statistical model, based on a small set of gamers, to work for larger populations. Part of the cheat-detection mechanism involves sending the data traffic to a graphics processing unit, which is a parallel server to make the process faster and take the workload off the main server's central processing unit. The researchers plan to extend their work to create an approach for games that do not use a client-server architecture and to make the detection mechanism more secure. Islam said gaming companies could use the UT Dallas technique with their own data to train gaming software to detect cheating. If cheating is detected, the system could take immediate action."After detection," Khan said, "we can give a warning and gracefully kick the player out if they continue with the cheating during a fixed time interval.

B. A. Akshaya Shree

III B.Sc. (Computer Technology)

WHEN IMPOSSIBLE BECOMES POSSIBLE

Have you dreamt of living in Pandora pictured in Avatar flim. It was an optical revolution when James Cameron conceived a fictional universe in which humans seek to mine unobtanium on the fictional explanatory moon. Even though it was a false ideas we can actually live in it if we wish too. Think about the situation in which we can simultaneously live in past, present and future. Ever wish to travel in a vessel across outer space? All this is now possible and achievable with Virtual Reality.

Virtual Reality helps us with modelling the World. It uses the computer technology to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience. The primary subject of virtual reality is simulating the vision. Virtual reality tricks your brain into believing you are in a 3D world. Do you ever imagine how it

really works? The first way VR does this is with the stereoscopic display. When we put on a VR headset it takes us to a simulated setup making us completely aloof from the actual surroundings.

Each VR headset puts up a screen (or two-one for each eye) in front of eyes thus, eliminating any interaction with the real world. Two autofocus lenses are generally placed between the screen and the eyes that adjust based on individual eye movement and positioning. The visuals on the screen are rendered either by using a mobile phone or HDMI cable connected to a PC. The movements of the user are captured in real time in order to animate virtual user, who interacts with the virtual environment. The effects of interaction between the virtual user and the virtual environment are restituted to the user senses through sensory feedback technologies. These technologies are constituted of visualization devices, sound feedback, tactile and force feedback, as well as motion platform. Interaction in virtual environment is realized through a relation between virtual environment and a virtual representation of the subject. Sense of presence is strongly dependent on the engagement of the body in the virtual immersion process. Thus, virtual reality tends to fully immerse the user in the virtual world. Among the major headsets avail- able today, Vive and Rift both have 110-degree FOVs, Google Cardboard has 90, the GearVR has 96 and the new Google Daydream offers upto 120 degrees. As for frame rate, both HTC Vive and Oculus Rift come with 90hz displays, while the PlayStation VR offers a 60hz display. VR was only confined to gaming well but it is already being put to any innovative and brilliant uses.

Military- Virtual Reality has been adopted by Military such as Army, Navy and Air Force to train the soldiers for combat and survival without putting them in any real harm's way.

Entertainment- Entertainment as such has come a long way in every sphere be it the special effects and VRF in movies or the Hi-tech gaming consoles. VR can be successfully applied to both of them as VR theatres and studios have already been initiated and many major names are set to launch their VR headsets for gaming and for an overall entertaining experience. Apart from games and movies VR can also be used to construct VR museums and VR theme parks.

Fashion- VR in Fashion is not a conventional concept but can be used in many ways such as designers can use VR for Virtual models to try out the designs in real time, take a tour through a fashion store anywhere in the world, attend

fashion shows in VR and run their own in a virtual world.

Business and Marketing- Many businesses are implementing VR in a cost effective way to construct prototypes which enables them to test the product without having to develop several builds and versions. VR in marketing is being used to let the customers know better of a product or a service. VR will be the new face of advertisement where a user will be able to test a product or service before actually buying or investing their money in.

Journalism- VR has also found its way in journalism where audiences can visit the sites in the VR and catch the whole action and news on any topic. The new projects of VR in Journalism are major such as Project Syria which takes people through the war torn Syria through a virtual tour.

Science and Nuclear Reality- VR can be employed to practice emergency responses in Virtual settings while dealing with Nuclear reactors. VR can be used for more than nuclear security it can help in a lot of new discoveries in science. VR can be used in Medicine, Physics, Chemistry, Biology and Engineering. Doctors can plan difficult and critical surgeries in VR.

Sports- Training of the players in sports can be done more efficiently and effectively with the use of VR. For instance football players could be trained through VR to view the game from different perspectives in order to react and respond in a better way.

Medical Science- VR has one best use for the overall betterment of humankind through medical science by training students through VR. Medical students could be prepared for any kind of surgery or treatment through Virtual Reality.

Investigating a Crime Scene- The investigative agencies and the police across the world could effectively employ VR to investigate a crime scene by revisiting it. Even the jury could use VR to visit the crime scene during a testimony before ruling out in any party's favour.

Virtual Reality can be successfully used in almost every profession and field only if we understand it in and out and use it to the best possible and maximum. There are lots of risks associated with the VR. Major VR Health Risks are Anxiety. The immersive nature of virtual and augmented reality can induce stress or anxiety after wearing a full occlusion headset for more than a few minutes. Some people who use VR headsets complain of dizziness and Eye strain, Radiation exposure etc. are the other health issues. The Lacks of Flexibility is the one of the corns of VR. As in the classroom, it is not possible for an open questions in VR. There is no scope for positive interaction. Another major drawback of VR is the addiction to Virtual Reality. The students can get addicted to the virtual world. The

section of the population is getting addicted to video games and the rest. And also in the world of Virtual Reality, one can even get addicted to harmful drugs.

D.Krishnakumar

III B.Sc. (Information Technology)

SYSTEM BRINGS DEEP LEARNING TO 'INTERNET OF THINGS' DEVICES

Advance could enable artificial intelligence on household appliances while enhancing data security and energy efficiency. Deep learning is everywhere. This branch of artificial intelligence curates your social media and serves your Google search results. Soon, deep learning could also check your vitals or set your thermostat. MIT researchers have developed a system that could bring deep learning neural networks to new and much smaller places, like the tiny computer chips in wearable medical devices, household appliances, and the 250 billion other objects that constitute the Internet of Things (IoT).

The system, called MCUNet, designs compact neural networks that deliver unprecedented speed and accuracy for deep learning on IoT devices, despite limited memory and processing power. The technology could facilitate the expansion of the IoT universe while saving energy and improving data security.

The research will be presented at next month's Conference on Neural Information Processing Systems. The lead author is Ji Lin, a PhD student in Song Han's lab in MIT's Department of Electrical Engineering and Computer Science. Co-authors include Han and Yujun Lin of MIT, Wei-Ming Chen of MIT and National University Taiwan, and John Cohn and Chuang Gan of the MIT-IBM Watson AI Lab.

The Internet of Things

The IoT was born in the early 1980s. Grad students at Carnegie Mellon University, including Mike Kazar '78, connected a Cola-Cola machine to the internet. The group's motivation was simple: laziness. They wanted to use their computers to confirm the machine was stocked before trekking from their office to make a purchase. It was the world's first internet-connected appliance. "This was pretty much treated as the punchline of a joke," says Kazar, now a Microsoft engineer. "No one expected billions of devices on the internet."

Since that Coke machine, everyday objects have become increasingly networked into the growing IoT. That includes everything from wearable heart monitors to smart fridges that tell you when you're low on milk. IoT devices often run on microcontrollers simple computer chips with no operating system, minimal processing power and less than one thousandth of the memory of a typical

smartphone. So pattern-recognition tasks like deep learning are difficult to run locally on IoT devices. For complex analysis, IoT collected data is often sent to the cloud, making it vulnerable to hacking.

"How do we deploy neural nets directly on these tiny devices? It's a new research area that's getting very hot," says Han. "Companies like Google and ARM are all working in this direction." Han is too. With MCUNet, Han's group codesigned two components needed for "tiny deep learning" the operation of neural networks on microcontrollers. One component is TinyEngine, an inference engine that directs resource management, akin to an operating system. TinyEngine is optimized to run a particular neural network structure, which is selected by MCUNet's other component: TinyNAS, a neural architecture search algorithm.

System-algorithm codesign

Designing a deep network for microcontrollers isn't easy. Existing neural architecture search techniques start with a big pool of possible network structures based on a predefined template, then they gradually find the one with high accuracy and low cost. While the method works, it's not the most efficient. "It can work pretty well for GPUs or smartphones," says Lin. "But it's been difficult to directly apply these techniques to tiny microcontrollers, because they are too small."

So Lin developed TinyNAS, a neural architecture search method that creates custom-sized networks. "We have a lot of microcontrollers that come with different power capacities and different memory sizes," says Lin. "So we developed the algorithm [TinyNAS] to optimize the search space for different microcontrollers." The customized nature of TinyNAS means it can generate compact neural networks with the best possible performance for a given microcontroller with no unnecessary parameters. "Then we deliver the final, efficient model to the microcontroller," say Lin.

To run that tiny neural network, a microcontroller also needs a lean inference engine. A typical inference engine carries some dead weight instructions for tasks it may rarely run. The extra code poses no problem for a laptop or smartphone, but it could easily overwhelm a microcontroller. "It doesn't have off-chip memory, and it doesn't have a disk," says Han. "Everything put together is just one megabyte of flash, so we have to really carefully manage such a small resource." Cue TinyEngine.

The researchers developed their inference engine in conjunction with TinyNAS. TinyEngine generates the essential code necessary to run TinyNAS' customized neural network. Any deadweight code is discarded, which cuts down on compile-time. "We keep only what we need," says Han. Since we

designed the neural network, we know exactly what we need. That's the advantage of system-algorithm codesign. In the group's tests of TinyEngine, the size of the compiled binary code was between 1.9 and five times smaller than comparable microcontroller inference engines from Google and ARM. TinyEngine also contains innovations that reduce runtime, including in-place depth-wise convolution, which cuts peak memory usage nearly in half. After codesigning TinyNAS and TinyEngine, Han's team put MCUNet to the test.

MCUNet's first challenge was image classification. The researchers used the ImageNet database to train the system with labeled images, then to test its ability to classify novel ones. On a commercial microcontroller they tested, MCUNet successfully classified 70.7 percent of the novel images the previous state-of-the-art neural network and inference engine combo was just 54 percent accurate. "Even a 1 percent improvement is considered significant," says Lin. "So this is a giant leap for microcontroller settings."

The team found similar results in ImageNet tests of three other microcontrollers. And on both speed and accuracy, MCUNet beat the competition for audio and visual "wake-word" tasks, where a user initiates an interaction with a computer using vocal cues (think: "Hey, Siri") or simply by entering a room. The experiments highlight MCUNet's adaptability to numerous applications.

Huge potential

The promising test results give Han hope that it will become the new industry standard for microcontrollers. "It has huge potential," he says. The advance "extends the frontier of deep neural network design even farther into the computational domain of small energy-efficient microcontrollers," says Kurt Keutzer, a computer scientist at the University of California at Berkeley who was not involved in the work. He adds that MCUNet could "bring intelligent computer-vision capabilities to even the simplest kitchen appliances, or enable more intelligent motion sensors." MCUNet could also make IoT devices more secure. "A key advantage is preserving privacy," says Han. "You don't need to transmit the data to the cloud."

Analyzing data locally reduces the risk of personal information being stolen including personal health data. Han envisions smart watches with MCUNet that don't just sense users' heartbeat, blood pressure, and oxygen levels, but also analyze and help them understand that information. MCUNet could also bring deep learning to IoT devices in vehicles and rural areas with limited internet access.

S.P Vishva

II B.Sc. (Information Technology)

HIGH THROUGHPUT INTELLIGENT COMPUTING PARADIGMS

The quest for high throughput intelligent computing paradigms for big data and artificial intelligence and the ever increasing volume of digital information has led to an intensified demand for high-speed and low-power consuming next-generation electronic devices. The 'forgotten' world of AntiFerroMagnets (AFM), a class of magnetic materials, offers promise in future electronic device development and complements present-day ferromagnet-based spintronic technologies.

Formidable challenges for AFM-based functional spintronic device development are high-speed electrical manipulation (recording), detection (retrieval), and ensuring the stability of the recorded information all in a semiconductor industry-friendly material system.

Researchers at Tohoku University, University of New South Wales (Australia), ETH Zürich (Switzerland), and Diamond Light Source (United Kingdom) successfully demonstrated current-induced switching in a polycrystalline metallic antiferromagnetic heterostructure with high thermal stability. The established findings show potential for information storage and processing technologies.

The research group used a Mn-based metallic AFM (PtMn)/heavy metal (HM) heterostructure attractive because of its significant antiferromagnetic anisotropy and its compatibility with Silicon-based electronics. Electrical recording of resistance states (1 or 0) was obtained through the spin-orbit interaction of the HM layer; a charge current in the adjacent HM resulted in spin-orbit torques acting on the AFM, leading to a change in the resistance level down to a microsecond regime.

"Interestingly, the switching degree is controllable by the strength of the current in the HM layer and shows long-term data retention capabilities," said Samik DuttaGupta, corresponding author of the study. "The experimental results from electrical measurements were supplemented by a magnetic X-ray imaging, helping to clarify the reversible nature of switching dynamics localized within nm-sized AFM domains."

The results are the first demonstration of current-induced switching of an industry-compatible AFM down to the microsecond regime within the field of metallic antiferromagnetic spintronics. These findings are expected to initiate new avenues for research and encourage further investigations

towards the realization of functional devices using metallic AFMs for information storage and processing technologies.

V.S. Malini

II B.Sc. (Information Technology)

A NEW WAY TO THINK ABOUT MACHINE LEARNING

Machine learning has delivered amazing results but there also have been failures, ranging from the harmless to potentially deadly. New work suggests that common assumptions about the cause behind these supposed malfunctions may be mistaken, information that is crucial for evaluating the reliability of these networks.

Deep neural networks, multilayered systems built to process images and other data through the use of mathematical modelling are a cornerstone of artificial intelligence. They are capable of seemingly sophisticated results, but they can also be fooled in ways that range from relatively harmless misidentifying one animal as another to potentially deadly if the network guiding a self-driving car misinterprets a stop sign as one indicating it is safe to proceed.

A philosopher with the University of Houston suggests in a paper published in *Nature* Machine Intelligence that common assumptions about the cause behind these supposed malfunctions may be mistaken, information that is crucial for evaluating the reliability of these networks.

As machine learning and other forms of artificial intelligence become more embedded in society, used in everything from automated teller machines to cybersecurity systems, Cameron Buckner, associate professor of philosophy at UH, said it is critical to understand the source of apparent failures caused by what researchers call "adversarial examples," when a deep neural network system misjudges images or other data when confronted with information outside the training inputs used to build the network. They're rare and are called "adversarial" because they are often created or discovered by another machine learning network a sort of brinksmanship in the machine learning world between more sophisticated methods to create adversarial examples and more sophisticated methods to detect and avoid them.

"Some of these adversarial events could instead be artifacts, and we need to better know what they are in order to know how reliable these networks are," Buckner said. In other words, the misfire could be caused by the interaction between what the network is asked to process and the actual patterns involved. That's not quite the same thing as being completely mistaken.

"Understanding the implications of adversarial examples requires exploring a third

possibility: that at least some of these patterns are artifacts," Buckner wrote. ". Thus, there are presently both costs in simply discarding these patterns and dangers in using them naively." Adversarial events that cause these machine learning systems to make mistakes aren't necessarily caused by intentional malfeasance, but that's where the highest risk comes in.

A security system based upon facial recognition technology could be hacked to allow a breach, for example, or decals could be placed on traffic signs that cause self-driving cars to misinterpret the sign, even though they appear harmless to the human observer.

Previous research has found that counter to previous assumptions, there are some naturally occurring adversarial examples times when a machine learning system misinterprets data through an unanticipated interaction rather than through an error in the data. They are rare and can be discovered only through the use of artificial intelligence.

These artifacts haven't been well understood; Buckner offers the analogy of a lens flare in a photograph a phenomenon that isn't caused by a defect in the camera lens but is instead produced by the interaction of light with the camera.

The lens flare potentially offers useful information the location of the sun, for example if you know how to interpret it. That, he said, raises the question of whether adverse events in machine learning that are caused by an artifact also have useful information to offer. Equally important, Buckner said, is that this new way of thinking about the way in which artifacts can affect deep neural networks suggests a misreading by the network shouldn't be automatically considered evidence that deep learning isn't valid.

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III B.Sc. (Information Technology)

SECURITY GAP ALLOWS EAVESDROPPING ON MOBILE PHONE CALLS

Calls via the LTE mobile network, also known as 4G, are encrypted and should therefore be tap-proof. However, researchers have shown that this is not always the case. They were able to decrypt the contents of telephone calls if they were in the same radio cell as their target, whose mobile phone they then called immediately following the call they wanted to intercept. They exploit a flaw that some manufacturers had made in implementing the base stations.

Reusing keys results in security gap

The vulnerability affects Voice over LTE, the telephone standard used for almost all mobile phone calls if they are not made via special messenger services. When two people call each other, a key is generated to encrypt the conversation. "The problem was that the same key was also reused for other calls," says David Rupprecht. Accordingly, if an attacker called one of the two people shortly after their conversation and recorded the encrypted traffic from the same cell, he or she would get the same key that secured the previous conversation.

"The attacker has to engage the victim in a conversation," explains David Rupprecht. "The longer the attacker talked to the victim, the more content of the previous conversation he or she was able to decrypt." For example, if attacker and victim spoke for five minutes, the attacker could later decode five minutes of the previous conversation.

Identifying relevant base stations via app

In order to determine how widespread the security gap was, the IT experts tested a number of randomly selected radio cells across Germany. The security gap affected 80 per cent of the analysed radio cells. By now, the manufacturers and mobile phone providers have updated the software of the base stations to fix the problem. David Rupprecht gives the all-clear: "We then tested several random radio cells all over Germany and haven't detected any problems since then," he says. Still, it can't be ruled out that there are radio cells somewhere in the world where the vulnerability occurs.

In order to track them down, the Bochum-based group has developed an app for Android devices. Tech-savvy volunteers can use it to help search worldwide for radio cells that still contain the security gap and report them to the HGI team. The researchers forward the information to the worldwide association of all mobile network operators, GSMA which ensures that the base stations are updated.

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A WEARABLE VIBRATION SENSOR FOR ACCURATE VOICE RECOGNITION

A voice-recognition feature can be easily found on mobile phones these days. Often times, we experience an incident where a speech recognition application is activated in the middle of a meeting or a conversation in the office. Sometimes, it is not activated at all regardless of numbers of times we call out the application. It is because a mobile phone uses a microphone which detects sound pressure to recognize voice and it is easily affected by surrounding noise and other obstacles.

Professor Kilwon Cho of Chemical Engineering and Professor Yoonyoung Chung

of Electronic and Electric Engineering from POSTECH successfully developed a flexible and wearable vibration responsive sensor. When this sensor is attached to a neck, it can precisely recognize voice through vibration of the neck skin and is not affected by ambient noise or the volume of sound. The conventional vibration sensors recognize voice through air vibration and the sensitivity decreases due to mechanical resonance and damping effect, therefore are not capable of measuring voices quantitatively. So, ambient sound or obstacles such as mouth mask can affect its accuracy of voice recognition and it cannot be used for security authentication.

In this study, the research group demonstrated that the voice pressure is proportional to the acceleration of neck skin vibration at various sound pressure levels from 40 to 70 dBSPL and they developed a vibration sensor utilizing the acceleration of skin vibration. The device, which is consisted of an ultrathin polymer film and a diaphragm with tiny holes, can sense voices quantitively by measuring the acceleration of skin vibration. They also successfully exhibited that the device can accurately recognize voice without vibrational distortion even in the noisy environment and at a very low voice volume with a mouth mask worn.

This research can be further extended to various voice-recognition applications such as an electronic skin, human-machine interface, wearable vocal healthcare monitoring device. Professor Kilwon Cho explained the meaning of this study in his interview. "This research is very meaningful in a way that it developed a new voice-recognition system which can quantitively sense and analyze voice and is not affected by the surroundings. It took a step forward from the conventional voice-recognition system that could only recognize voice qualitatively."

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SERVERLESS COMPUTING

Serverless computing is a cloud computing execution model in which the cloud provider runs the server and dynamically manages the allocation of machine resources. Pricing is based on the actual amount of resources consumed by an application, rather than on pre-purchased units of capacity. It can be a form of utility computing. Serverless is a misnomer in the sense that servers are still used by cloud service providers to execute code for developers. The management and details of these servers are transparent to the application developers.

Serverless computing can simplify the process of deploying code into production. Scaling, capacity planning and maintenance operations may be hidden from the developer or operator. Serverless code can be used in conjunction with code deployed in traditional styles, such as microservices. Alternatively, applications can be written to be purely serverless and use no provisioned servers at all.[2] This should not be confused with computing or networking models that do not require an actual server to function such as peer-to-peer (P2P).

Serverless runtimes

Most, but not all, serverless vendors offer compute runtimes, also known as function as a service (FaaS) platforms which execute application logic but do not store data. The first "pay as you go" code execution platform was Zimki released in 2006 but it was not commercially successful. In 2008, Google released Google App Engine, which featured metered billing for applications that used a custom Python framework but could not execute

Serverless Databases

Several serverless databases have emerged in the last few years. These systems extend the serverless execution model to the RDBMS, eliminating the need to provision or scale virtualized or physical database hardware. Nutanix offers a solution named Era which turns an existing RDBMS such as Oracle, MariaDB, PostgreSQL or Microsoft SQL Server into a serverless service. Amazon Aurora offers a serverless version of its databases, based on MySQL and PostgreSQL, providing on-demand, auto-scaling configurations.

Azure Data Lake is a highly scalable data storage and analytics service. The service is hosted in Azure, Microsoft's public cloud. Azure Data Lake Analytics provides a distributed infrastructure that can dynamically allocate or de-allocate resources so customers pay for only the services they use. Firebase, also owned by Google includes a hierarchical database and is available via fixed and pay-as-you-go plans.

Advantages

Cost

Serverless can be more cost-effective than renting or purchasing a fixed quantity of servers, which generally involves significant periods of underutilization or idle time. It can even be more cost-efficient than provisioning an autoscaling group due to more efficient bin-

packing of the underlying machine resources. This can be described as pay-as-you-go computing or bare-code as you are charged based solely upon the time and memory allocated to run your code; without associated fees for idle time.

Immediate cost benefits are related to the lack of operating systems costs, including: licences, installation, dependencies, maintenance, support, and patching.

Elasticity versus scalability

In addition, a serverless architecture means that developers and operators do not need to spend time setting up and tuning autoscaling policies or systems; the cloud provider is responsible for scaling the capacity to the demand. As cloud native systems inherently scale down as well as up, these systems are known as elastic rather than scalable.

Small teams of developers are able to run code themselves without the dependence upon teams of infrastructure and support engineers more developers are becoming DevOps skilled and distinctions between being a software developer or hardware engineer are blurring.

Productivity

With function as a service, the units of code exposed to the outside world are simple event driven functions. This means that typically, the programmer does not have to worry about multithreading or directly handling HTTP requests in their code, simplifying the task of back-end software development.

Boomeshwaran J

III B.Sc. (Computer Technology)

QUANTITATIVE APTITUDE

1. A sum of money at simple interest amounts to Rs. 815 in 3 years and to Rs. 854 in 4 years. The sum is:

A. Rs. 650

B. Rs. 690

C. Rs. 698

D. Rs. 700

Answer: C

2. A person crosses a 600 m long street in 5 minutes. What is his speed in km per hour?

A. 3.6

B. 7.2

C. 8.4

D. 10

Answer: B
Explanation:

Speed = $\left(\frac{600}{5 \times 60}\right)$ m/sec.

= 2 m/sec.

Converting m/sec to km/hr

$= \left(2 \times \frac{18}{5}\right)$ km/hr

= 7.2 km/hr.

3. Today is Monday. After 61 days, it will be:

A. Wednesday

B. Saturday

C. Tuesday

D. Thursday

Answer: B
Explanation:
Each day of the week is repeated after 7 days.
So, after 63 days, it will be Monday.

∴ After 61 days, it will be Saturday.

4. A, B and C can do a piece of work in 20, 30 and 60 days respectively. In how many days can A do the work if he is assisted by B and C on every third day?

A. 12 days

B. 15 days

C. 16 days

D. 18 days

Answer: B
Explanation:

A's 2 day's work = $\left(\frac{1}{20} \times 2\right) = \frac{1}{10}$.

(A + B + C)'s 1 $\left(\frac{1}{} + \frac{1}{} + \frac{1}{}\right) = \frac{6}{} = \frac{1}{}$.

day's work = 20 30 60 60 10

Work done in 3 days = $\left(\frac{1}{10} + \frac{1}{10}\right) = \frac{1}{5}$.

Now, $\frac{1}{5}$ work is done in 3 days.

∴ Whole work will be done in (3 x 5) = 15 days.

5. 8, 27, 64, 100, 125, 216, 343

A. 27

B. 100

C. 125

D. 343

Answer: B
Explanation:
100 is not a perfect cube.

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LOGICAL REASONING

1. Tanya is older than Eric.
Cliff is older than Tanya.
Eric is older than Cliff.
If the first two statements are true, the third statement is

A. true

B. false

C. uncertain

Answer: Option **B**

Explanation:

Because the first two statements are true, Eric is the youngest of the three, so the third statement must be false.

2. Which word does NOT belong with the others?

A. inch

B. ounce

C. centimeter

D. yard

Answer: Option **B**

Explanation:

An ounce measures weight; the other choices measure length.

3. **Statements:** In a one day cricket match, the total runs made by a team were 200. Out of these 160 runs were made by spinners.

Conclusions:

80% of the team consists of spinners.

The opening batsmen were spinners.

A. Only conclusion I follows

B. Only conclusion II follows

C. Either I or II follows

D. Neither I nor II follows

Answer: Option **D**

Explanation:

According to the statement, 80% of the total runs were made by spinners. So, I does not follow. Nothing about the opening batsmen is mentioned in the statement. So, II also does not follow.

4. Look at this series: 53, 53, 40, 40, 27, 27, ...
What number should come next?

A. 12

B. 14

C. 27

D. 53

Answer: Option **B**

Explanation:

In this series, each number is repeated, then 13 is subtracted to arrive at the next number.

5. Melt : Liquid :: Freeze :

A. Ice

B. Solid

C. Condense

D. Push

Answer: B. Solid

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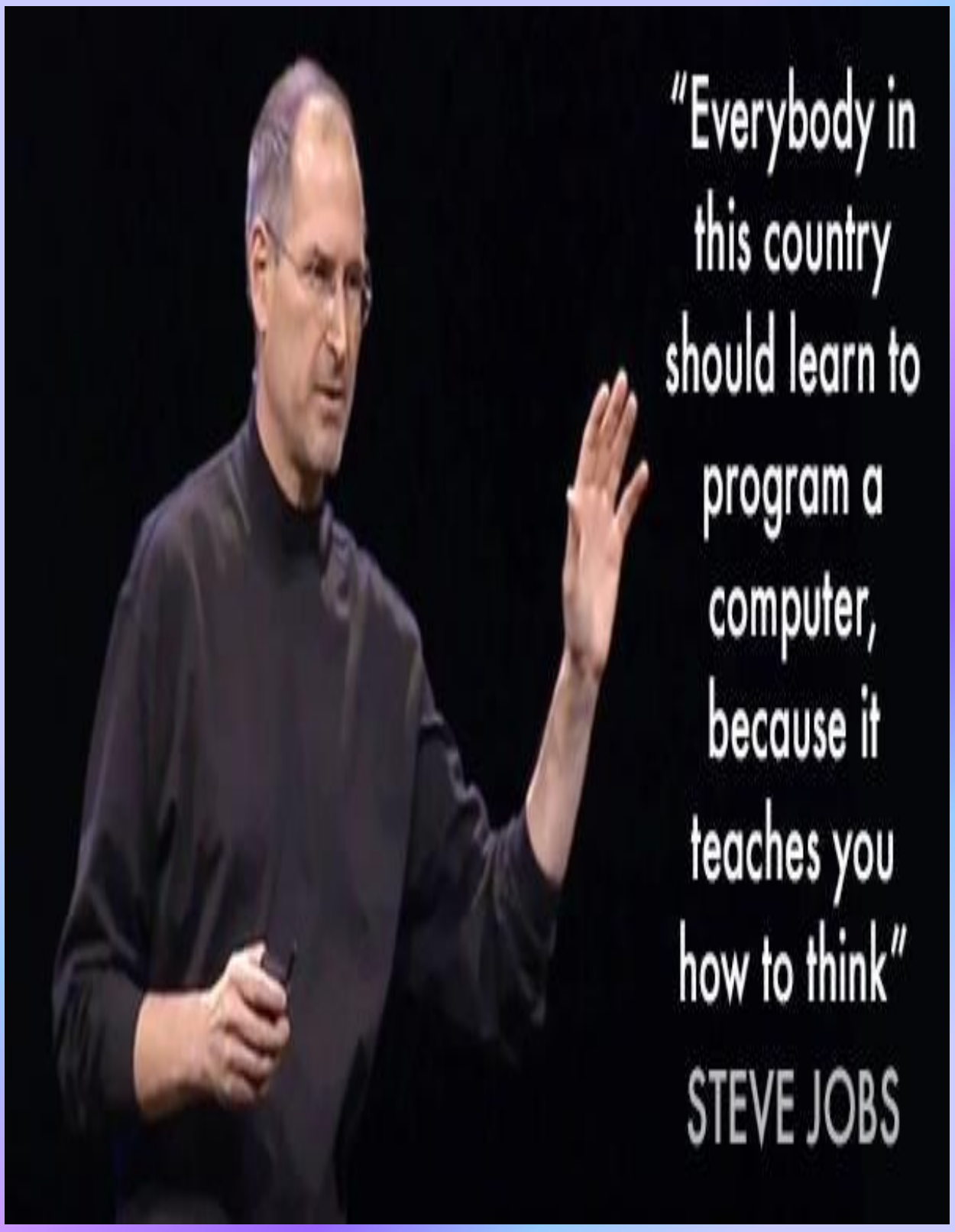
"Everybody in this country should learn to program a computer, because it teaches you how to think"
STEVE JOBS

Steve Jobs