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Applications of Neural Networks - Survey Paper

As Enis Berk Coban stated in their research paper, "*Neural networks can be seen just like another successful machine learning algorithm to solve different problems, however the biggest companies in the world are investing billions of dollars on deep learning and related infrastructure research."*(Çoban, 2016). The deep learning algorithm possibilities offered by intelligent AI are why they are such a huge asset in today's modernized society. To have a machine capable of not only lightning-speed quantum computing, but to also be able to make decisions and choices based on complex communication networks replicated from the layout of our own neural pathways is astounding to most. The thought of such an intellectually strong machine by the general public is relatable to the idea of far-fetched science-fiction ideas like lasers and giant robots. Which most believe to be incredibly farther down our species evolutionary timeline. Though you can find today that these super-intelligent machines and algorithms are being actively researched, developed, and programmed by a variety of companies and independent parties; catapulting us all into the future of machine intelligence.

The graph to the right shows an example of how the structure and architecture of a neural network would look. An ANN(Artificial Neural Network) is composed of 3 separate layers that work together to produce a final outcome. Each 'neuron', seen as the red dots, is fired and starts at the input layer, where information is received and slightly computed. It is then sent to the hidden layers, which are seen as the driving work force behind the entire network. The yellow dots inside said hidden layers are multiple neuron modules, which will receive one or more separately "weighted" inputs, and sum them to produce the final output. Adding weight to our modules is the same as adding learnable parameters;

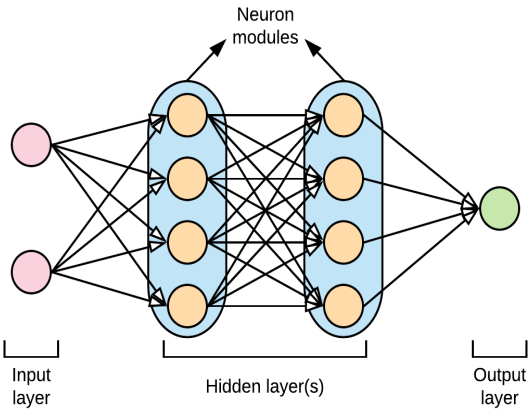


Image Source: https://ekababisong.org/iece-ompi-workshop/deep_learning/

and as the neurons are continued to be trained, the weight is adjusted accordingly to achieve the desired output. The inputs themselves also are passed through non-linear functions known as “activation” or “transfer” functions, which will tell the artificial neuron when to commence firing.

Now that an understanding of an ANN has been established, a discussion of the myriad of applications can begin. Since the dawn of computer science and the idea of artificial intelligence, the question of “How can a machine like this be of use?” has been asked. An important aspect of everyday life that AI can immensely support the general public in, would be the healthcare system. As the rate of technological development increases with each year, human life-expectancies slowly increase accordingly. The image to the right shows a database architecture structured around a medical center. With each practitioner, patient, and consultant having their own unique IDs attached to them. The patient tab gets a bit more complex, with age and gender becoming informational factors now needing to be input into the system. By having an AI with powerful neural networking capabilities able to navigate medical records and databases instantly, you can save a wide range of costs and possibly lives in the process. As the old adage goes, “Time is money” and a quick-thinking AI can solve that adage instantaneously.

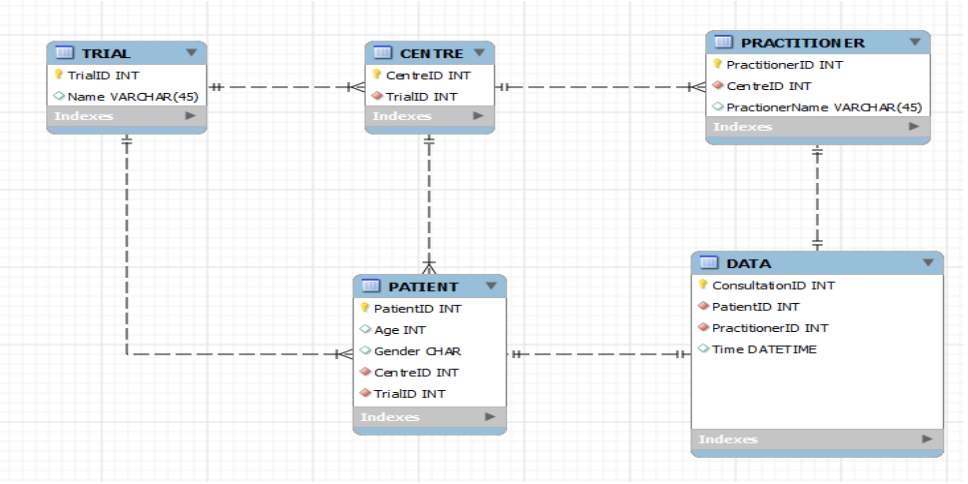


Image Source: https://dba.stackexchange.com/questions/58884/does-this-medical-database-look-correct

Visual processing in relation to medical imaging also plays an important role in the benefits and applications of AI in the field of medicine. An example is stated by Proxet CEO & Founder Vlad Medvedovsky in a recent 2021 analysis on his company website, saying *“IMV Medical Information Division, a specialized market research company, reported that 6.5 million MRI scans had been postponed in the USA alone due to the pandemic.”*(Medvedovsky, 2021) By making the process of

medical imaging more efficient and thorough through the implementation of artificial visual processing, a healthcare professional will no longer need to rely on outdated and slow equipment. The entire process in itself to process medical images can become costly, with complex and expensive machinery being operated by professionals. The real world benefits by this increase in efficiency can be seen through lowered stress levels from the patient receiving their test results faster, a more thorough elimination of any image distortions or errors, and ensuring the patient's overall health and safety by providing them with faster scanning times; thus receiving less exposure to harmful radiation.

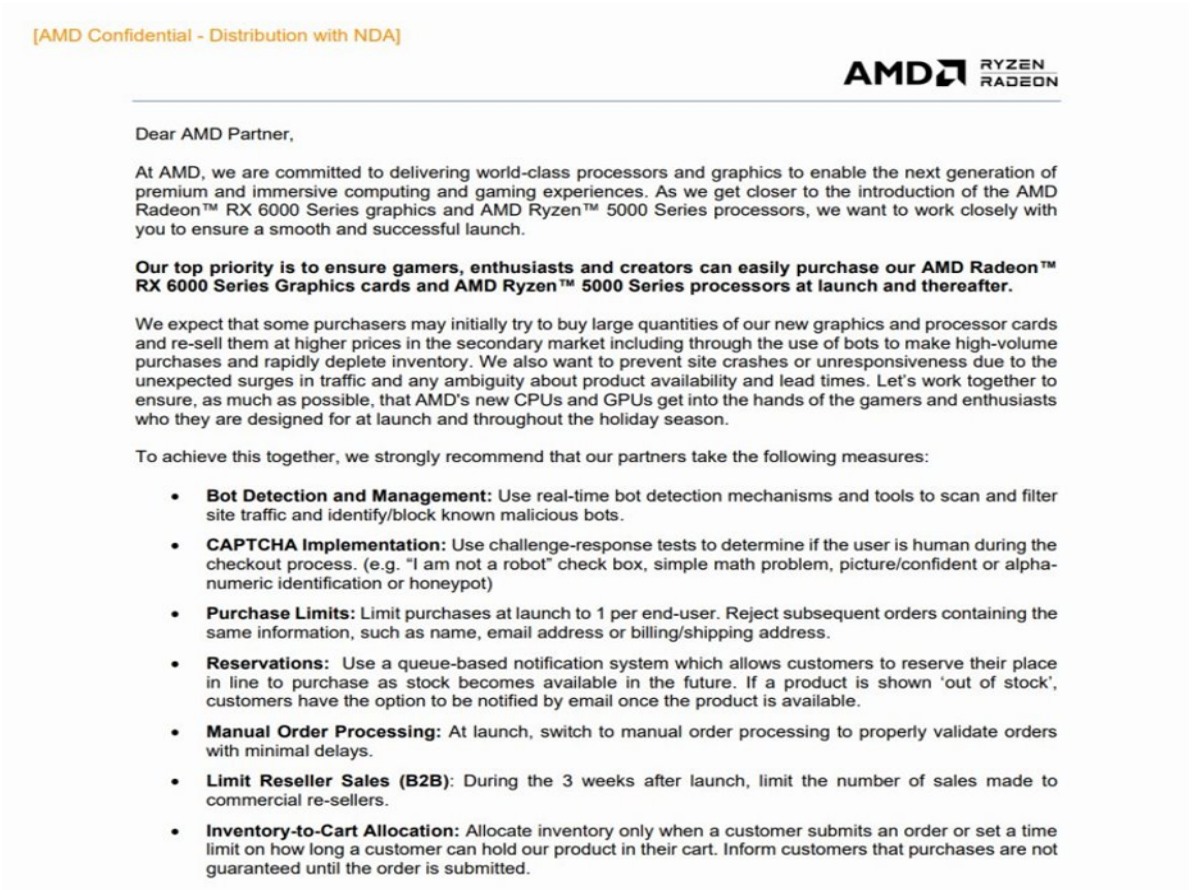
In life, to every yin that exists, there must be some sort of yang. The same sadly applies with most applications of artificial intelligence. The height of popularity for AI applications was around 2016-2018, with Tesla unveiling their famous semi-autonomous vehicle model that used a highly intelligent traffic-aware AI program to reduce accidents and ensure driver safety during their journey. Tesla CEO Elon Musk stated himself that he believes AI will one day become even more dangerous and life-threatening to the human race than a nuclear weapon. These bold claims do not go unsupported, as a quick analysis into how AI applications can be maliciously tampered with shows the very possible dangers.

A company may decide to implement speech recognition security measures in order for an employee to gain access to an area with highly sensitive materials. Though someone with malicious intent may be able to design or get access to an AI program that uses a complex learning algorithm that gathers audio recordings off a speech recognition database, then replicates the desired voice based on the available audio input given by the hacker. A program capable of a feat such as this is already widely available to the public, called "Resemble". This program allows you to build a personalized AI voice based on pre-existing audio data, thus creating an artificial human voice with somewhat emotional tones and human mannerisms in their speech by using a voice learning algorithm.

Another plausible danger of AI being integrated into society are the rise of bots and fake users on the internet. If you venture into any social media platform or forum-based website, you will most definitely come across a comment or profile that looks fabricated and autonomous in nature. An example

of how something as small as a singular hyper-intelligent AI bot could be very impactful to the economy, is with Sony & Microsoft's recent release of the new generation gaming consoles. Malicious users were looking to buy the consoles in bulk on days they were restocked, to then sell them on market-listing websites at skyrocketed prices. Around 2018-2019, bots were able to reach the intelligence to bypass the standard reCAPTCHA v2, which would make the user select the correct images out of a group in order to correctly bypass the CAPTCHA. Version 3 now has to use a reputation-based system, with users gaining a higher more positive reputation when having non-malicious or questionable bot-behaviour/activity occur on their google account. Tushar Richabadas stated in a recent 2021 article on AppSec predicting the growth in intelligence of AI bots; *"The AMD example is quite interesting in that it prescribes specific bot mitigation measures — including the use of CAPTCHAs, purchase limitations per account, reservations, bot management solutions, and much more. Many of these solutions don't phase today's bot makers. CAPTCHAs, including reCAPTCHAv3, are quite easily bypassable by bots, and they can get around most other methods as well, with the exception of advanced bot*

Image Source:
https://blog.barracuda.com/2021/01/20/appsec-predictions-2021-bots-get-bigger-and-smarter/#:~:text=Bots%20will%20grow%20smarter%20and%20become%20a%20bigger,growing%20in%20popularity%20over%20the%20past%20few%20years.



[AMD Confidential - Distribution with NDA]

AMD RYZEN RADEON

Dear AMD Partner,

At AMD, we are committed to delivering world-class processors and graphics to enable the next generation of premium and immersive computing and gaming experiences. As we get closer to the introduction of the AMD Radeon™ RX 6000 Series graphics and AMD Ryzen™ 5000 Series processors, we want to work closely with you to ensure a smooth and successful launch.

Our top priority is to ensure gamers, enthusiasts and creators can easily purchase our AMD Radeon™ RX 6000 Series Graphics cards and AMD Ryzen™ 5000 Series processors at launch and thereafter.

We expect that some purchasers may initially try to buy large quantities of our new graphics and processor cards and re-sell them at higher prices in the secondary market including through the use of bots to make high-volume purchases and rapidly deplete inventory. We also want to prevent site crashes or unresponsiveness due to the unexpected surges in traffic and any ambiguity about product availability and lead times. Let's work together to ensure, as much as possible, that AMD's new CPUs and GPUs get into the hands of the gamers and enthusiasts who they are designed for at launch and throughout the holiday season.

To achieve this together, we strongly recommend that our partners take the following measures:

- **Bot Detection and Management:** Use real-time bot detection mechanisms and tools to scan and filter site traffic and identify/block known malicious bots.
- **CAPTCHA Implementation:** Use challenge-response tests to determine if the user is human during the checkout process. (e.g. "I am not a robot" check box, simple math problem, picture/confident or alpha-numeric identification or honeypot)
- **Purchase Limits:** Limit purchases at launch to 1 per end-user. Reject subsequent orders containing the same information, such as name, email address or billing/shipping address.
- **Reservations:** Use a queue-based notification system which allows customers to reserve their place in line to purchase as stock becomes available in the future. If a product is shown 'out of stock', customers have the option to be notified by email once the product is available.
- **Manual Order Processing:** At launch, switch to manual order processing to properly validate orders with minimal delays.
- **Limit Reseller Sales (B2B)**: During the 3 weeks after launch, limit the number of sales made to commercial re-sellers.
- **Inventory-to-Cart Allocation:** Allocate inventory only when a customer submits an order or set a time limit on how long a customer can hold our product in their cart. Inform customers that purchases are not guaranteed until the order is submitted.

management solutions."(Richabadas, 2021). It is apparent in the mass-email sent by AMD to their customers what Richabadas meant by companies emphasizing how important bot protection has become for both the user and the business.

The future of neural networks being applied to machines across the market is a grey area, with no limitations in place and unlimited freedom for researchers and developers alike. One day we may see Elon Musk's Neuralink chip as a basic installation upon birth to grant users an enhanced life granted by AI-powered brain chips. As seen by the various articles in this paper, it is entirely up to the individual applying AI whether it is for positive or hostile intent. The exponential growth in not only passion for neural networks, but funding as well, is only a few signs of many of the impending future where machines retain their super-intelligence; while also gaining the vital human attribute of complex thought-processing and decision-making skills.

Sources:

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- **Sources for all images/graphs used in paper found above or below the image in bold text.**