**INTERNSHIP DAILY UPDATES**

**(30th June – 30th July) by Ira Rai**

**Under Prof Udayan Ganguly.**

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| 30th June | Discussion of work to be done. |
| 1st July | Read the paper: Supervised deep convolutional generative adversarial networks, In the paper they have tried to build categories in the generator model by placing random numbers on specific positions. The positions differentiate the categories. |
| 2nd July | Read the paper: Generative Adversarial Networks An Overview. |
| 3rd July | Continued studying and understanding GANs. |
| 4th July | * Created a discriminator network for the MNIST dataset in Python in a Google colab file according to the convolutional layers used in the Paper: Supervised deep convolutional generative adversarial networks |
| 5th July | * Had an online meeting with Paritosh to clarify some doubts in the paper read above, and discussed the further making of the Generator network. He explained how in actuality we would use random noise data from stochastic processes like resistive RAMs and ferroelectric switching. * **Aim: To build a GAN model first (Algorithmic part on software), then we will make subsequent changes to use the model in a chip.** |
| 6th July | Built a generator model along with the Loss functions needed for Supervised GANs. Some errors are coming due to input size, have to debug. |
| 7th July | Read the diffusion model blog suggested by Paritosh and some papers related to diffusion models. |
| 8th July | - |
| 9th July | Created an Unsupervised GAN model, this model is gives an accuracy of 82 with 20 epochs. |
| 10th July | Tried to debug, an unsupervised model, but the error persists saying that some attributes are run by cpu and some by gpu. Studied the maths of diffusion models. |
| 11th July | * Collected doubts related to SNN and diffusion models to be discussed with Paritosh. * **Successfully** **debugged the supervised DCGAN model**, now it can generate images with 82% accuracy from 20 epochs, will try increasing the epochs for better accuracy. In the paper, the fake images generated by GANs were accurately similar to real ones, their epoch was 40. * Had a brief meeting related to further work and doubt discussion. |
| 12th July | * Had a 2 hr discussion with Paritosh on some doubts related to ion conductance in neurons and mathematical models based on that. Had a better understanding of stochasticity in materials and project outlining. * Further tasks include going through the Project overview report, diffusion models and Quantum Tunneling Based Ultra-Compact and Energy Efficient Spiking Neuron Enables Hardware SNN shared by Paritosh, * Alongside also see if I can make the GAN model to print the images generated at every possible step, to observe the change in each iteration. |
| 13th July | Read paper on Quantum Tunneling Based Ultra-Compact and Energy Efficient Spiking Neuron Enables Hardware SNN, have some doubts to be discussed. |
| 14th July | Corrected GAN model to get the noise generated, fake\_images, and real\_images at every epoch. |
| 15th July | Studied the Leaky integrate and fire model and Huxley model through lectures and Neuronal dynamics pdf. |
| 16th July | - |
| 17th July | - |
| 18th July | * Studied basic neuronal dynamics through lectures and a book by Gerstner. * Had a meeting with Paritosh and Ajay to clear doubts in the paper Quantum Tunneling Based Ultra-Compact and Energy Efficient Spiking Neuron Enables Hardware SNN. * I understood how we need to introduce Stochasticity in the noise input vector and initialize the weights, mostly we will use FeRAM or Resistive RAMs. |
| 19th July | The new aim is to design a Project outline for implementing GAN in hardware, paper “A survey of GAN hardware architecture” will be used. I started reading this paper. To get to know what hardware architectures are required for building the chip architecture. |
| 20th July | * Reading paper A survey of GAN hardware architecture * .I understood that we will mostly try with the hybrid mode and that the model will consist of Processing elements,on-chip mesh interconnect, VMME, buffers and registers, ADCs for the convolution and DeCONV operations. * Now I have to figure out a design to take the convolutional layers specified in supervised DCGAN and replace them with hardware architecture. |
| 21st July | Read a paper on spiking diffusion models and compared it with the model by Anmol in the Electrical blog. The spiking diffusion model paper had the following points:  Input (noise) -> spikes -> Resblock -> U(t)(accumulative membrane potential) -> if(U(t) >Vthres) -> output spike -> propogated to next layer -> Predicted noise. |
| 22nd July | Made a figure representing the flow of project: We get the stochastic data from FeRAM devices, it passes through the network and updates the weight, this would be one epoch in the hybrid model. |
| 23rd July | Studied the next chapter in neuronal dynamics (The ion channels) |
| 24th July | - |
| 25th July | Brainstorming and doubt discussing session with Paritosh on project-related, reconfigurable Neural Networks and SNN lectures. I was curious about how we can mimic the brain by working on a single piece of hardware that can reconfigure itself according to the tasks that are required form the model.  Read a paper on NN hardware. |
| 26th July | Had a meeting to discuss the project outline;  Read about variational autoencoders. |
| 27th July | Performed experiment on semiconductor analysis device:  We fixed a silicon wafer witht the help of probes.  Then studied the chart depicted the address of every device. We needed to fix the probe at ferroelectric devices among pads.  Then the current was passed, their always some femtoampere current due to static electricity from atmosphere around.  The transform characteristics received showed random variations which were not expected, the cause was some error which can be rectified by changing the probe. So the experiment has to be done again.  Read variational autoencoders. |
| 28th July | Performed the experiment again, and got the expected graph showing the transform characteristics.  Learned transistors' characteristic curves and the reason for their stochasticity.  Read GANs from the suggested Data science website. |
| 29th July | Discussion on GAN-related doubts from the Data Science site. Understood how the model is creating noise samples**.The final outline for the project was discussed as getting the parameters from which the noise vector will be modelled, this would be used to make the generator learn and weights in devices will be updated; the whole process accounts as 1 epoch.** |
| 30th July | - |