NFT artwork generation using oscillatory activation functions in GANs

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Abstract

The concept of digital ownership is not new, and has been widely used in gaming contexts to allow players to customize their experiences via profile pictures, skins, upgrades and add-ons. In this paper we propose a novel model for NFT generation which uses Oscillatory activation function instead of other mainstream activation functions. Here, we are using a combination of GCU and ReLU to train the model and the subsequently use for the prediction. We have used the Bored Apes Yacht Club Dataset[4] available here. This dataset contains 10,000 images of famous NFTs from Bored Apes Yacht Club. NFTs will accelerate the growth of the cryptocurrency space outside of finance, and will bring novel ideas and approaches from new sets of creators, artists, collectors of digital items, developers and more.

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1 Introduction

NFTs are cryptographic tokens built on the Ethereum blockchain. NFTs are "minted," then sold, just like Bitcoin. The difference, though, is that Bitcoin is "fungible." If you swap Bitcoin with someone, you both still have the same asset: some amount of Bitcoin. There's no functional difference between one Bitcoin or another. However, NFTs are "non-fungible." Each token is unique, and that token proves that you, and only you, have ownership rights over a digital asset. NFTs make it possible to verify ownership of digital assets. Before NFTs, there was no widely accepted way to determine the "original" piece of a digital artwork. There was also no widely accepted way to prove or transfer its ownership. NFTs have changed that, and with it, they're changing the world of art. "We feel very confident that this is just the beginning for NFTs," says Meghan Doyle, a cataloguer of post-war and contemporary art at auction house Christie's. "There is tremendous potential for NFTs in the art market and beyond. As a mechanism, the potential that NFTs have to shift the way that we establish ownership has no bounds."

With this ability to mint ownership of digital assets, NFTs have transformed how artists and creators make a living while changing how we buy, sell, and relate to art. NFTs also have expanded interest in blockchain technology beyond investment in Bitcoin and Ethereum. Experts still debate whether NFTs are the future of art or just a fad, but the amount of money changing hands for art backed by NFTs has the art world, technologists, and financiers paying attention. The biggest mainstream use of NFTs today is for artwork, thanks to Beeple's big sale. NFTs are so prevalent in art because digitally native creators can bestow scarcity on works that consist entirely of pixels, says Doyle at Christie's. They enable creators to earn more than they would outside the restrictions of the fine art world. Today, creators typically only get paid when they initially sell a piece of artwork; should the artwork's new owner sell it to someone else, they pocket any gains made—and the artist gets nothing. However, NFTs use smart contracts to verify ownership and terms.

2 Background and Related Work

A. What are NFTs?

NFT stands for a non-fungible token, which means that hidden in these quirky pieces of art and digital items, there is a totally unique and non-interchangeable unit of data stored on a digital ledger that uses blockchain technology to establish proof of ownership. NFTs are collectible digital assets that hold value, just like how physical art holds value, so do NFTs. These tokens are representative of physical or digital creative work or intellectual property including audio clips, digital art, games and more. These tokens consist of digital information in the form of media (music, video, image) the value of which can be calculated in terms of cryptocurrencies. The NFTs are part of the Ethereum blockchain in particular but differ from Ethereum coins which are fungible, that is, exchangeable with similar types of assets. "Nonfungible" in NFT means that each token is not exchangeable with another token, making each token a unique entity that represents a single specific object. NFT submarkets are cointegrated and feature various causal short-run connections between them.

B. What is an Allowlist?

An allow is essentially a method of pre-registering for an NFT drop to gain access to purchasing. Many allowlists will require specific information, sometimes requiring your social handles and most importantly your wallet ID/ address (most commonly, and ERC 20 address).

C. What does minting mean?

Minting an NFT is how your digital art becomes a part of the blockchain — a public ledger that is unchangeable and tamper-proof. Similar to how a real-life coin is minted, it is the process of the token is put into circulation. It is the building block to how your token gets digitally tracked as it is resold and collected in the future.

D. Blockchain:

Blockchain is a secure medium for data storage, but because of its computational and network limitations, it is not ideal for handling large amounts of data. Blockchain supports digital assets, which predominantly take the form of cryptocurrencies and tokens. It encompasses the whole network of computers. Bitcoin was the first cryptocurrency to leverage blockchain technology. Blockchain is a sort of distributed ledger technology [5] in which transactions are stored using an irreversible cryptographic signature known as a hash, and blocks can be authenticated by the network using cryptographic means. This concept ensures the blockchain's integrity all the way to the first block. As the hash values are unique, fraud can be detected because modifications to a block in the chain changes the hash value immediately. Because of the decentralized structure of blockchain, all transactions can be transparently viewed.

E. Ethereum:

Ethereum is a community-run technology software platform that enables hundreds of decentralized apps to be built and deployed. Ethereum is based on blockchain technology. It is a blockchain with a built-in Turingcomplete programming language. It has an abstract layer that allows anyone to define their own ownership, transaction formats, and state transition methods. This is accomplished through the use of smart contracts, which are a collection of cryptographic rules that are only performed if specific terms are satisfied. Ethereum consists of EOA and Contract. The EOA is controlled by a private key while Contract accounts are controlled through contract code. An account consists of four things: nonce, ether balance, contract code hash, and storage root.

F. Oscillatory functions:

Oscillatory activation functions comprises of multiple hyperplanes in their decision boundary. This enables the neurons to make more complex decisions than other popular sigmoidal, ReLu like Swish, and Mish activation functions. The higher representative power of networks with oscillating activation functions allows classification and regression tasks to be solved with fewer neurons. Also, the oscillations in the activation function appear to improve gradient flow and speed up back propagation learning[20]. The results presented in [20] suggest that deep networks with oscillating activation functions might potentially partially bridge the performance gap between biological and artificial neural networks. Oscillatory functions have been proved to outperform many other activation functions. The better performance can be noticed with benchmarking as well. Not only standardized, but also domain specific datasets can be used to test different use cases. For instance, testing these oscillatory activations on high entropy feature space [13] still remains a task, some of the prominent problems in this vertical include compression algorithms classification, which was earlier addressed with a reasonable accuracy across various compression classes using CNN backbone. Further experimentation using oscillatory activations could be done to better identify features in such datasets.

G. GCU[19]

GCU was first proposed in [19], where this new activation function outperformed Sigmoids, Swish, Mish and ReLU. The activation is represented as $C(z) = z.cosz$.

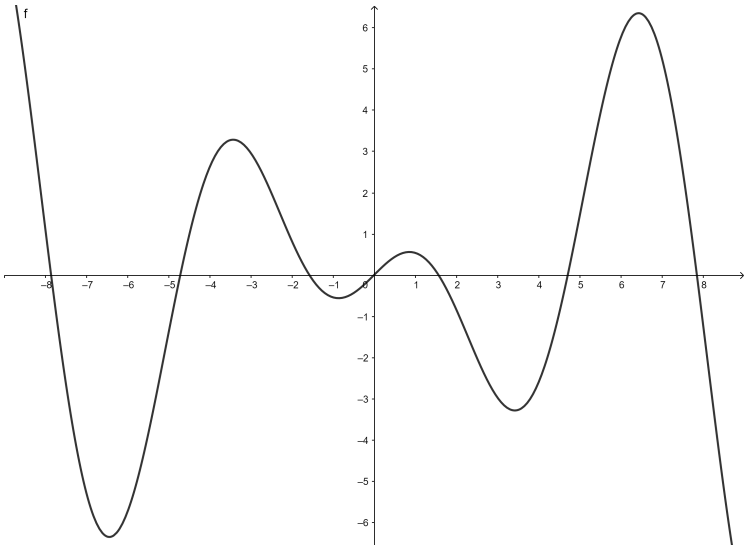

Figure 1: GCU activation function [6]

H. ReLU[1]

It is known that the deep neural networks having only sigmoidal activation functions are hard to train. The vanishing gradient phenomenon [17] is responsible for this difficulty, which arises when saturating activation functions are used. Non-saturating and non-sigmoidal Recti-Linear Unit (ReLU) activation function assuages the vanishing gradient problem. However, there are some drawbacks of ReLU like activation functions, these are presented by the authors in [19].

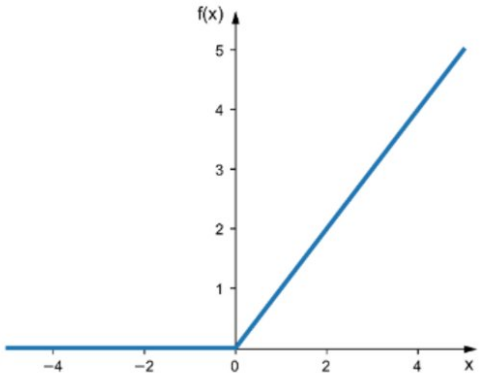

Figure 2: ReLU function graph [22]

3 BAYC Dataset

Board Apes dataset has 10000 images of board apes. Tuning of the images are done. After loss calculation, there is weight updation. In training, for every 15 epoches, result is displayed. Images are converted into gif.

The NFT sector has seen exponential growth, tripling the number of transactions since the beginning of 2021, and this trend has not abated even during major market pullbacks.

Figure 3: Images from the BAYC dataset

4 Why GANs are used for NFTs creation?

GANs are deep learning architectures that are widely and effectively used for synthesis of audio, images, and video contents. However, their application to NFT arts have been limited. Results from the qualitative case study indicate that the generated artworks are comparable to the real samples in terms of being interesting and inspiring and they were judged to be more innovative than real samples. This paper presents a novel NFT art generation application using GANs. It presents a novel NFT art generation application trained using GANs. It provides a quantitative evaluation and a qualitative case study of NFT arts generated using GANs.

5 Results and Discussion

Figure 4: Generator has tricked Discriminator that 0.3 % images are real

Image generated using GCU and ReLU as activation functions within the layer

Figure 5: Generator has tricked Discriminator that 6.3 % images are real

6 Conclusion

NFTs have provided a novel solution to a persistent issue within the digital art ecosystem: how does an artist maintain scarcity of a digital art piece when it can be so easily copied and distributed? In the material world, verifiers and authenticators can examine art pieces to determine if they are reproductions. While this process is not immune to forgery, it provides enough confidence to buyers that they are willing to transact on expensive art pieces. In the NFT ecosystem, if a participant claims to own a digital art piece, any third party can examine the history of transactions on the blockchain to see if in fact the participant's cryptographic key is associated with the piece. If the rightful owner decides to sell it again, a new transaction record will be imprinted on the blockchain so any third party can examine the chain of custody of that NFT. Therefore, although the NFT can be copied, as long as there is consensus within the blockchain network of the identifying hash of that NFT, anyone can verify its ownership. Among the several oscillatory activation functions we used in the proposed model for NFT generation, GCU and ReLU are giving good results. Additionally, Conditional Generative Adversarial networks[15] and it's variants could be used to further constraint the output space for generative modeling.

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