USING BLOCKCHAIN IN LITERARY STUDIES

by

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DEDICATION

To my loving parents Myung Hee Kim and In Ha Kim, my brother Young Kim, and my amazing support system without whom this thesis would have never been written.

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LIST OF ABBREVIATIONS

Application-Specific Integrated Circuit	ASIC
Artificial Intelligence	AI
Artificial General Intelligence	AGI
Artificial Narrow Intelligence	ANI
Artificial Neural Networks	ANNs
Artificial Super Intelligence	ASI
Cryptocurrency	Crypto
Decentralized Autonomous Organization	DAO
Decentralized Applications	dApp
Digital Humanities	DH
Distributed Ledger Technology	DLT
George Mason University	GMU
Graphics Processing Unit	GPU
High-Level Machine Intelligence	HLMI
Measuring Usability of Systems in Context	MUSiC
Multi-Factor Authentication	MFA
Natural Language Processing	NLP
Non-Fungible Token	NFT
Peer-to-Peer exchange	P2P
Proof of Authority	PoA
Proof of Capacity	POC
Proof of Space	PoSpace
Proof of Stake	PoS
Proof of Work	PoW
Recurrent Neural Network Language Model	RNNLM
Simulated Neural Networks	SNNs
Single Point of Failure	SPOF
Wishful Automatic Spanish Poet	WASP

ABSTRACT

USING BLOCKCHAIN IN LITERARY STUDIES

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This work reviews literary studies in a digital environment by exploring conversations concerning the digital humanities, then introduces the intersection of literature and blockchain technology and theory. The aim is to navigate Blockchain within the humanities, specifically literary studies and to further investigate if the application of blockchain can provide sustainable and manageable solutions for the limitations of institutional access. This thesis explores blockchain's deployment across various domains and highlights how specific characteristics of this disruptive technology can resolve issues involving trust, funding, access, and the preservation of materials in literary studies. By investigating current conversations related to blockchain and fields of study similar to literary study, I disseminate an appropriate thesis to theorize the future integrity and shortcomings of blockchain technology in literary studies. With the blend of Artificial Intelligence with blockchain technologies is to encourage the use of blockchain theology and technology for the future application in literary studies.

INTRODUCTION

Whether you are a faculty member, unaffiliated with an institution, or a student trying to finish their thesis project—research is difficult. It requires a lot of our time and focus, and things can become complicated while we're researching. But the use of digital tools can help our process. However, utilizing new technology seems to be taboo because the humanities focus on human-based inquiry rather than more technical research based on scientific processes.

As part of a research project during my graduate studies, we were instructed to select a novel of our choice, with multiple editions of the same print. We then had to search and analyze which editions were readily available and accessible to us, either online or in-person. During my research, I encountered several issues regarding access and research. I was inspired to seek possible solutions for what limited my own research process which in turn led me to conversations about Blockchain. This research is to navigate Blockchain in the humanities, specifically literary studies. I wanted to provide a basic understanding of blockchain technology to see the potential it advocates for in literary analysis and research. And examine the limitations of access, data management, and academic institutional library or publishing acquisition.

The thesis is organized as follows. In Chapter 1, I present the epistemology and methodological approach for my research. Discussing my experience and inspiration, any initial questions, ideas, and themes I was curious about, to explore what ultimately inspired my project about blockchain. Chapter 2 presents a literature review focusing on Blockchain and Artificial Intelligence (AI), and their potential uses in the digital humanities. By investigating the conversations and research about these topics that have been in circulation, I begin to establish a more complex understanding of what is addressed and what I can introduce. In Chapter 3, I provide a definition and overview of blockchain. I offer theoretical and real-life examples to create perspective and discuss the benefits and discrepancies of Blockchain related to literary research. In Chapter 4, I provide foundational information about AI and briefly overview AI's history and potential by elaborating on its relevance. And, address how the collaboration between AI with blockchain can resolve the limitations of blockchain such as scalability, privacy, regulation and security. In Chapter 5, I further elaborate on the relationship between blockchain and AI to demonstrate how, together, blockchain can effectively be implemented into the humanities, literary research and its research process. I also recognize the intersection of the two separate technologies creates an opening for the deployment of blockchain. To understand the application and implementation of blockchain, I examine humanists' reaction to digital tools to encourage an open mind toward the adoption of innovative technology. The thesis concludes with a reflection on significant implications and future research opportunities for the use of Blockchain in literary studies.

CHAPTER ONE: BLOCKCHAIN AND ME

Most university MA programs encourage and, often require their graduate students to research and produce a thesis project, but my program at George Mason University (GMU) was a little different. The graduate literature program at GMU offers a choice between completing a semester-long project or a more traditional two-semester thesis, intended to produce a more substantial research project. Both options require an immense amount of time, dedication, and passion to complete. Of course, I was over-ambitious and wanted to gain the most from my time in my program. So, I decided to write a thesis, but I didn't know where to start. Everyone has already discussed the majority of nuanced theories and conversations about the Victorian and 19th century American and British novels and narratives that I planned to focus my research on—I didn't feel like anything I contributed would be new or grand enough to make an entrance into academia. I wanted something new and exciting, something that separated me from other students. So, I consulted a few of my professors to get a better picture of what I was missing or if a thesis was worthwhile with the few ideas I had in mind. However, after a conversation or two, I realized my ideas were lackluster and not bringing something new to the field. If I was going to write and publish my research, I wanted something worthwhile. So, I decided to continue to explore which avenues of research I would be interested in pursuing to expand my portfolio.

After my first semester at Mason, I planned to attend my first Modern Language Association conference with the intention to practice my networking skills and attend seminars to gain a better understanding of the job market in academia, but also to explore other fields of research I may be interested in. I attended seminars on book history and book making, and a few seminars related to pedagogy, but one seminar caught my interest. It was a seminar panel with researchers in the digital humanities who were doing interesting and incredible things, such as research on Internet trolling, library database studies, and digital archiving. My conference experience showed that I could explore other fields of study within the humanities that related to my studies in literature. There was so much more I hadn't been introduced to, but instead of hunting for answers in fields I had become acquainted with, I started to consider any challenges I may have encountered during my undergraduate and graduate studies for a possible research topic. As we all know, inquiry begins with questions. So, I considered a research project I had finished during my first semester at Mason, I previously mentioned where we selected a novel with multiple editions to analyze the editions' significance. We then assessed what changes were made within each edition and conduct additional research to find where original manuscripts could be found, and where other editions were and could be located.

For this project, I selected *Far from the Madding Crowd* by Thomas Hardy (1874). But I underestimated how difficult it would be to find multiple editions, most importantly multiple "significant" editions to the novel's history. From my research, I noticed I was only able to receive a few copies of different editions from the GMU library. Utilizing the Interlibrary Loan (ILL) system, I had collected about 10 editions, the earliest, physical copy from 1895 and the latest from 1932. Other editions I consulted were compiled as partials from online scans, images, and descriptions of the contents of each edition. Although I was equipped with institutional access to find some editions from the GMU Library, I was unable to get my hands on any other significant editions either virtually or by mail and was able to view only partial sections of editions necessary for the objective of my project.

While working on this project, I noticed there was a gap in collecting reliable and credible, virtual editions. Some editions I found appeared to need discretion and further evaluation to determine their provenance and whether any unauthorized edits had been to the original text. While researching, I found myself struggling to efficiently collect research without having to thoroughly evaluate and analyze the minute details of my sources. I wondered if there was a way to eliminate or minimize source evaluation, such as finding information about the same topic when there is a slight variation in numbers, dates, statistics, etc. that may need a second look. But as researchers, the demand for research versus the time it takes to produce research is unbalanced. So, I was curious about other ways to improve research production and its efficiency without having to sacrifice its quality. I also had concerns about access. As a student, I have institutional access to online journals and databases and do not have to break the bank with subscriptions and memberships. But, if I was not a student, I would not have access to the GMU library, nor its subscriptions and memberships. So, I wondered how those unaffiliated with an institution could gain access to scholarly conversations without having to subscribe and pay for access. Would they go to the public library, use search engines like Google, or only view open access research? What is the difference between institutional access versus public access that limits research? Why are we gatekeeping, withholding information, when society values accuracy? Do we have subscriptions because of funding issues, or is it because we are safeguarding information? I couldn't help but wonder why producing research was so important, when there were so many obstacles that didn't prioritize the research being done.

It was also during this time that conversations about Blockchain, cryptocurrency (crypto), Bitcoin, and Ethereum were a dinner topic especially during the early peak of the Bitcoin currency trade in 2018. I was intrigued by the goals of the cryptocurrency Ethereum, which essentially aims to use a decentralized blockchain to unify the digital world, creating one enormous global computer. With a growing interest in understanding cryptocurrency and computational data tracking research, I was enticed to find how interdisciplinary Blockchain was. As blockchain already had established relationships with finance, I wanted to explore other disciplines that have utilized and benefited from blockchain such as healthcare, the music industry, and creative writing. I believed there was potential to have a sustainable, adaptable addition to digital toolkits to improve the quantity and quality of humanities or literary research produced using adaptable concepts from blockchain and artificial intelligence (AI). The goal of this project is to provide an approachable and accessible definition of Blockchain that fits within the humanities' standards, or more specifically, literary studies' goals of improving research and research production.

CHAPTER TWO: LITERATURE REVIEW

Technology has and is changing the landscape in academia, and technology is a significant part of academic life. We have gone from using papyrus to parchment, the printing press, and the Internet. Technology has impacted both texts and researchers in significant ways, redefining both scholarship and practice. It offers us the opportunity in a digital environment to continue studying literature and promote more efficient and progressive research.

Technology is Always Advancing

Over time, as technology continues to grow, "so has the volume and variety of content online" (Borgman, 2014, p.1). Although some content available online is unverified or lacks credibility, "a substantial portion of online content is extremely valuable for scholarship" (Borgman, 2014, p.1). Technology has grown at such an exponential rate compared to our knowledge of its current and potential uses—it is difficult to stay current. It is ineffective to consistently build and re-build situational, digital tools when we can build a technical framework, which

> for scholarship is much easier than understanding what to build, for whom, for what purposes, and how their usage of the technologies will evolve over time. People will adopt new technologies if they perceive a sufficient advantage over the present methods to justify the costs and efforts involved. Once adopted, they will continually adapt those technologies to their practices. With experience, people identify new and unforeseen uses of tools, products, and services. Often

> neither the designers nor the potential users of a technology can anticipate its value—or lack thereof—months or years into the future. (Borgman, 2018, p. 3).

A technical framework such as Blockchain could be adopted if researchers recognize a significant improvement over what they were currently using. The digital age provides space for innovation and growth, and "changes in scholarly publishing can be attributed partly to the 'pull' of new technologies and partly to the 'push' of institutional restructuring" (Borgman, 2014, p. 76). The "pull of new technologies" such as Blockchain and the "push" of "the roles of scholars, publishers, and librarians that existed in the print world is now askew" (Borgman, 2017, p. 77) because a digital environment provides new opportunities and tools to conduct research. However, the insistence upon using these tools may be gradually restructuring how research is conducted utilizing technology for effective and efficient research.

Why don't humanities researchers use digital tools?

Humanities researchers seem reluctant to use digital tools, they are convinced a new practice is more effective than their original methods. Other researchers understand that technology is an integral part of research but cannot abandon methods that are already effective. Bruce R. Smith's (2014) "Getting back to the library, getting back to the body" addresses some of the fundamental limitations of digital technology like how "digital images do not fully communicate the physicality of what they represent" (p. 27). Smith explains his personal experience with institutional access, recognizing that online resources provide immediate resources and instant functions that we may need while conducting our research like keyword searches within a digital text. However, Smith argues that when we use technology, we deprive ourselves of the physical or 'living' experience of research. Ultimately, understanding that there are multidimensional limitations and advantages of technology, Smith says "the ideal state of knowledge, it seems to me, is one that combines the accessibility and search capability of electronic texts with the multidimensionality of the books and manuscripts that the digital images represent" (2014, p. 30). It is the combination of both the digital world and the physical world that creates an advantage.

Farim Karim-Cooper (2014) examines what is gained from digitization and open access but also considers the illusory nature of the digital research resource and its impact on scholarly identity. Recognizing that digitization is useful and important when "developing networks and partnerships with cultural organizations, creating high impact projects such as the digitization of archival documents and making available free and open digital resources all count positively towards a scholar's score in the Research Excellence Framework" (pp. 37-38). But these digitized documents cannot replace the missing components of 'physically' reading from a text versus a reading a PDF. Digital materials cannot replace the book but can provide other ways to see and experience the same materials.

Adam Hammond (2016) in *Literature in the Digital Age: An Introduction* argues that "no group is more sensitive to changes inherent in the shift to digital forms than readers of literature. What the digital age has accomplished, above all else, is to defamiliarize the act of reading" (p. 4). This is not because we have stopped reading or studying literature, but because we have been offered other choices to read and evaluate texts, thus influencing how we approach text. Thus, as the digital shift advances, reading from a text seems more and more impractical. Hammond re-addresses this idea by stating how “this is because reading *created* the very mindset that the digital age is now dismantling (2016, p. 5). Because of digital forms we are reading more than ever: Maryanne Wolf (2020), who observes from a study that people consume “the equivalent of close to 100,000 words a day” (p. 72). However, what form we are reading in a digital environment differs both from print and across different digital media.

Clay Shirky (2008) reasons that “the Internet has brought reading back as an activity[…] But because the return of reading has not brought about the return of the cultural icons we’d been emptily praising all these years, the enormity of the historical shift away from literary culture is now becoming clear” (para. 8-9). Hammond (2018) argues that researchers should focus on the new artistic possibilities of “a democratic, inclusive, post-literary digital age” (p. 8). The digital age offers innovation and “the main event is trying to shape the greatest expansion of expressive capability the world has ever known” (Shirky, 2008, para. 17). So, if we don’t start to use digital tools our research can become irrelevant. We don’t want to lose “touch with a rising generation of young scholars who will see us as nothing more than cranky old scholars hanging onto an old system because it serves our interests—not theirs” (Millis Kelly, 2013, p. 54). Researchers recognize that things are changing in the humanities but cling to the safety of outdated practices.

What do we need to keep up?

There is a high demand for new, innovative research, but also a delay in its production because "the amount of data produced far exceeds the capabilities of manual techniques for data management […] Scholarly documents are becoming larger, more complex digital objects. New tools and services are needed to produce, publish, distribute, and manage these objects" (Borgman, 2018, p. 6). New tools, such as Blockchain would accommodate the management, distribution, verification, and authorization of access to published work; it supports a secure, decentralized transparent record keeping system that has supported other fields. However, the pressure for researchers to use technology they are unfamiliar with or newer technological practices affects an entire chain or community that is a part of the research process:

> The effects of technology on research and research publishing in scientific subjects have long been obvious; but in the arts, too, technological developments now affect the researcher (whether he studies texts and uses concordances, or whether he amasses and analyzes quantities of data), the writer (who is more and more likely to compose on a word processor), the publisher (who has at his disposal new methods book production, and new media publication), the librarian (who will use computers for cataloging and circulation control), the reader (who has access now to facsimile, hypertext and other novel aids to study), and the bookseller (who will expose the new technology in many ways which others present will know better than I do. (Anthony Kenny, 1991, p. 2-3)

Thus, to understand the potential of blockchain in literary studies, it is important to address the goals of research, the main purpose of communicating the results of research, and understanding if current technologies serve their purpose in conversation with new technologies.

Being more open to what digital tools in digital environments may produce can offer new opportunities to further develop our research. In *Digital Humanities in Practice,* Claire Warwick (2012) demonstrates the importance of understanding the behaviors of humanities researchers and how digital tools and resources will be designed in the future. Warwick continues to explain how we "cannot and must not tell users what they ought to like, need, or use," but instead should ensure users know what they need in order to be successful (p. 18), whether they choose to use it or not. Digital tools have always been present in the humanities but have become more prevalent in our highly, digitally reliant culture. Considering the effects of technological change on the dissemination of research "The idea is that in today's world of networked communications the digital humanities have a special role to play in helping the humanities reach out" (Liu, 2013, 490). The humanities have always intermingled and been part of digital culture. And by doing so, the outcomes of being adaptable and open to new tools such as Blockchain can be useful and further progress our research.

Why don't we share?

Researchers have always had the tendency to keep their work secret. Yes, it is accessible with our institutional access; and yes, incomplete or unfinished research is shared at conferences or round table discussions, but we've already taken the time to research with intentions to share, but are reluctant to do so. So, why are we gatekeeping our research? It is not that researchers are intentionally reserving their research—although it may seem that way. There is actually what Anthony Kenny calls a "chain of research communication," which

> links together researcher, author, publisher, bookseller, librarian, reviewer, and reader. In the humanities one can say, with a slight exaggeration, that the chain of research communication is a closed one. Producers and consumers are the same community: the standard reader of academic publications is a researcher, and it is in reading, above all, that research in the arts considers. The different members of the communication chain have a common interest in the continued operation of the chain; but their interests can also diverge. (1991, p.1)

Their common interests are what researchers today consider when contributing to the academic conversation. And it is "[a]cademic researchers discovering new scientific truth, or if I need a historical record, or making the art and literature of the past accessible to the present, they are *eo ipso* confirming a benefit on the human race (whether or not the results are exploitable in any crude sense). Research, whether private or public, are more likely to have in mind the possibility that research will increase the economic potential of the nation" (Kenny, p. 2). There is interest in continuing the academic conversation, whether the research is private or public. We should be encouraged to continue collaborate and build on one another's contributions without feeling restricted or pressured to do so. Sharing data today has never been more accessible and effective due to "the technology of digital libraries and the Internet" (Borgman, 2018, p. 8). Yet, researchers postpone sharing their work until it is finalized. Chad Black (2013) argues that making the research process more open and available will only benefit researchers. Chad Black (2013) addresses how "The technologies of the web have revolutionized the potential of collections in the everyday moments of their original production. Rather than putting research processes and materials behind the veils of time, space, and limited access to our eclectic collections" (p. 48). By making the research process transparent, it would demonstrate and elaborate on what researchers do when researching, and "the world of the mystical reality of what it is academic historians do with time" (p. 48). Transparency would also "demonstrate a commitment to the scholarly values of exchange, integrity, and open access that represent the better parts of academics' nature" (Black, 2013, p. 48). And, by distributing "self-generated collections of archival material will also enhance access—particularly to resources from countries without the resources to do it all themselves. Finally, it would keep researchers honest" (Black, 2013, p. 48). Researchers should share their work to be transparent with their audience, to share what they were already going to share, to better promote the research they are already doing. And to be honest about the research process.

Blockchain

Commonly associated with cryptocurrency, Bitcoin, or business/ financial models, blockchain technology has been making headway since the late 1970s, gaining considerable attention due to its decentralized and multimodal structure. Software engineer and developer Christopher Knight provides an overview of Blockchain technology and its impact on our digital world by providing a definition of Blockchain as “a distributed database that stores a ledger of records and transactions that are immutable once added” (2017, para. 2). Knight states: “Blockchains are exciting, but certainly not imminent. The immense potential to upend our comfortable communication pathways can even be unnerving at times. There is a lot of research, experimentation, and implementation needed to take this technology towards a mass public adoption” (2017, para. 35-36). Knight admits that there is something exciting about blockchain but concludes there is no immediate change—not everything will switch to using blockchain. However, since he has published this article, blockchain technologies have expanded and been utilized in other disciplines such as healthcare, education, and music.

Michael Nofer, Peter Gomber, Oliver Hinz, and Dirk Schiereck’s (2017) article provides a nuanced overview of the functionality and implications of blockchain, elaborates on the definitions of blockchains, and signaling how many businesses may restructure their business models if people started to organize and protect utilizing a decentralized platform (Nofer et al., 2017). Nofer et al. (2017) writes that “a blockchain consists of data sets which are composed of a chain of data packages (blocks) where a block comprises multiple transactions. The blockchain is extended by each additional block and hence represents a complete ledger of the transaction history” (p. 183-184). I will cover more about Blockchain in the next chapter, but Nofer et al. (2017) recognize Blockchain’s association with finance, where it provides a way to securely exchange money or keep records secure\. They also note that “this disruptive innovation has not only the potential to change the nature of interactions in Finance, but also in many other areas of our everyday life" (p. 186). They understand and consider how the intersection blockchain technology and business are valuable as it continues to develop.

Kevin Werbach's (2018), *The Blockchain and the New Architecture of Trust* surveys blockchain technologies and the ecosystems related to and surrounding Blockchain. Werbach explores the general notion of trust and, again, how the blockchain and technologies fit to improve its implementation and availability. Werbach believes blockchain is a foundational technology that could have a great impact on the entire world, once the dust has settled. Blockchain can be used in a variety of ways, in various fields; some of these uses may be dead ends, or exploited while others may change the world significantly. Werbach demonstrates why Blockchain is much more than an incomprehensible cryptographic method, but an efficient synchronization in a distributed system (Werbach, 2019). Werbach not only recognizes the potential of Blockchain, but instructs on how society must understand the discrepancies and consequences Blockchain has and can help address. He then refocuses users' attention on the benefits of Blockchain as an immutable database. It is important to understand and keep in mind that in the blockchain ledger, when all globally distributed nodes work with the same level of information, it can avoid making irrelevant or incorrect decisions.

Blockchain is a self-automated program built from a series of codes and algorithms. The foundation of Blockchain or blockchain technologies have inspired and been questioned by many. Some believe Blockchain is the invention of the ages since the Internet, and others are uncertain of what Blockchain is—it can even be considered its own belief system. But like the Internet and religion, they depend on the faith and work of humans. Sandra Braman (2018) describes blockchain as appearing "purely technical" but it is actually "sociotechnical in nature. Humans are essential to its performance: proof of work systems that support major platforms depend on miners, decisions about investing in blockchain hardware and software are made by humans, people are critical to blockchain operations in a variety of contractor and curator roles, and it is on the basis of human subjectivity that blockchains rise and fall" (pp. iv-x). Humans are essential to Blockchain, and the incorporation of digital tools like Blockchain does not to eliminate humans, but rather provides tools to help humans accomplish their goals.

The Internet is sociotechnical and relies on humans—and so does Blockchain. Therefore, just as when the Internet was initially accepted, "trust the process" with blockchain. Angela Woodall and Sharon Ringel's (2020) article, "Blockchain Archival discourse: Trust and the Imaginaries of Digital Preservation," discusses the potential of blockchain in academia by *trusting* the technology "To make blockchain relevant as an archival strategy, trust is defined in relation to integrity, authenticity, and reliability" (p. 2212). Trust is much more complex than simply allowing something to happen because it was unanimous or agreed upon. Sometimes things can go wrong which can negatively affect our trust. We may feel vulnerable, but trust is being confident with vulnerability. It is also being confident in verification and accountability, which a blockchain could administer. Kevin Werbach (2018) believes that "blockchain does not eliminate the need for trust. It represents, rather, the reemergence of trust in a new form" (p. 3). Blockchain technology emphasizes its ability to secure and consistently fact-check information. When there is an incursion or breach, the program alerts those involved and keeps an automated record of this. This is extremely useful in finance because it is a secure ledger system, but it could also be used in other disciplines such as archival work, library studies, or even in literary studies. By improving or implementing a reliable log system this ledger system would keep a record of the entire history of a user's track log on a particular resource. Moreover, archival studies involve both the physical items of information and the filing and maintenance of this system, so this could also benefit the organization and maintenance of the filing system as well.

Artificial Intelligence

The machines artificially incorporated with human-like intelligence perform tasks like humans. Artificial Intelligence is built using complex algorithms and mathematical functions. AI is only here to help enrich humans' experience and assist with repetitive tasks or complex thinking. Andres Guadamuz (2017) says "the rise of the machines is here, but they do not come as conquerors, they come as creators." Dan Fabbri, a chief data scientist for Secure Link discusses the future of AI and Machine Learning in healthcare. Fabbri (2021) poses important questions the healthcare industry is curious about such as: How does the tool work, or where are my data stored? Discussing recent adoption and use of AI and machine learning in healthcare role of AI in future developments in healthcare.

A successful example of the use of AI in security is in Kurt Measom's (2021) "The future of AI integration with secured entrances," where he discusses how integrated solutions using advanced analytics and AI can improve security functionality from security entrances. Measom (2021) demonstrates how "AI can be used as a proactive step against intrusion at a security entrance like a swing door or turnstile and integrated into the access control and video security systems to provide rich analytics and situational awareness" (para. 9). Here, the use of AI offers another layer of security at entrances, eliminating the need for excessive machinery or obstacles, especially during the pandemic. But perhaps more importantly, it also manages and organizes data concerning access control and security recordings.

Isa Jones (2022), a writer and content manager for Secure Link, discusses how AI benefits access control in healthcare in "How Artificial Intelligence—3 Cybersecurity Insights for Health System Leaders. Access control, much like its name, is a way to limit or control access to a system or physical or virtual resources. Utilizing AI or machine learning technology helps automatically verify whether access is appropriate in healthcare. AI with Blockchain can work as reciprocal structures to support one another. Vivian B. Lobo, Jetsi Analin, Ronald M. Laban, and Shradda S. More (2020) demonstrated how AI provided the roadmap for analyzing data to discover drug and preventive healthcare in a blockchain-based decentralized healthcare system. Essentially, AI is a tool that can help humans do tasks more efficiently, by mimicking human behaviors and actions, while a blockchain provides a secure, immutable digital ledger to manage datasets. Hence, AI has the potential to reach boundless concepts and expertise for research in various fields, and has already made significant progress in security, healthcare, etc.

How does Blockchain relate to the Humanities?

Anne Burdick, Johanna Drucker, Peter Lunenfeld, Todd Presner, and Jeffery Schnapp (2012) discuss how "Digital Humanities represents a major expansion of the purview of the humanities, precisely because it brings the values, representational and interpretative practices, meaning-making strategies, complexities, and ambiguities of being human into every realm of experience and knowledge and meaning-making" (vii). Within a digital environment, we seem to continue to investigate new environments and tools to understand the expansion of the humanities. Thus, the digital humanities could be interpreted as the digital culture of text or a different interpretation and representation of text.

Matthew Kirschenbaum's (2019), "What is Digital Humanities and What's It Doing in English Departments" examines how "text has been by far the most tractable data type for computers to manipulate…" (p. 9). Text is not only at the disposal of scholars in the English department, but also for those looking for more answers or knowledge, like scholars, institutions, researchers, etc., and is a multi-disciplinary resource. Digital culture has always been present in the humanities, but has become more prevalent in our highly digitally reliant research today. The humanities have been part of the digital age, and technological programs such as Blockchain can further progress research in academia as it is introduced into various disciplines. Digital Humanities offers a place for Blockchain to be applied and studied within the humanities.

CHAPTER THREE: BLOCKCHAIN MAPPING LITERARY STUDIES

Blockchain can be difficult to grasp, which is a fair statement—it's complex. It is filled with jargon, so bear with me. Because of its ambiguity and unfamiliarity, I wanted to break down blockchain technology to provide a better understanding of what it is and what it can do for the humanities by building a better picture and contextualizing a clear landscape of Blockchain in literary studies. This thesis is intended to provide a basic understanding of Blockchain in the literary space of research and literature analysis.

So, what is Blockchain?

Blockchain is commonly associated with cryptocurrency such as Bitcoin or Ethereum. Blockchain is complex because the foundational knowledge of Blockchain is based on philosophy, mathematics, cryptography, and research in computer science. It is inspired by philosophy and economic theory, cryptography, mathematics, peer-to-peer networks, and digital currencies. The term blockchain is a misnomer. Once we separate the compound word 'block' and 'chain', block refers to a collection of data and data records. Chain refers to a public database of these blocks, stored as a list; where it can be linked to or navigated towards.

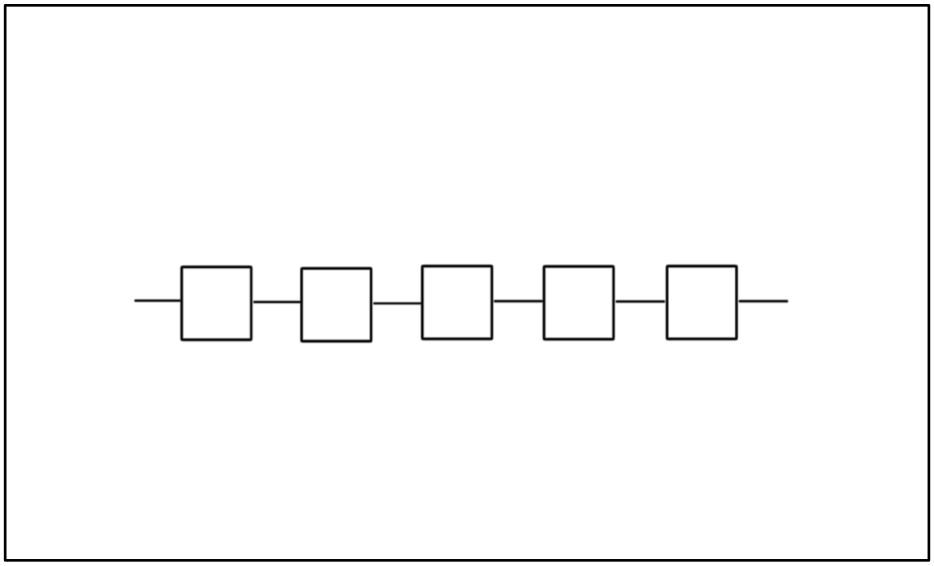

Figure 1. Preliminary understanding of what a blockchain may look like

A blockchain is assumed to appear or be a singular, infinite chain, when in fact it can be a formable collection of connections of data. Figure 1 illustrates an initial representation of what a blockchain may be perceived to be. Blockchain is essentially a collection of data sets that are timestamped and distributed amongst the network, or known as distributed ledger technology (DLT). DLT is a decentralized database managed by multiple participants. In a blockchain transaction, a transaction is requested, authenticated, and a representative block is created in its place. It is then sent to every node that is part of the network for a consensus process. A node is a computer, participant, or miner in a network. The nodes then validate the transaction using a consensus algorithm such as a proof of work, proof of stake, or another consensus algorithm, and the representative block is officially added to the existing blockchain. A thing to keep in mind about blockchains is that every block is connected to its previous block. Meaning a new block retains the previous and new blocks' data and before being added onto the ledger as its own block. So, once the update is distributed across the network of nodes the transaction is complete, and the block is added onto the ledger.

Another way to visualize blockchain is similar to a mind map, also known as a concept map or word web. Let's go back to English class and practice brainstorming on the topic: Blockchain. Where to begin?

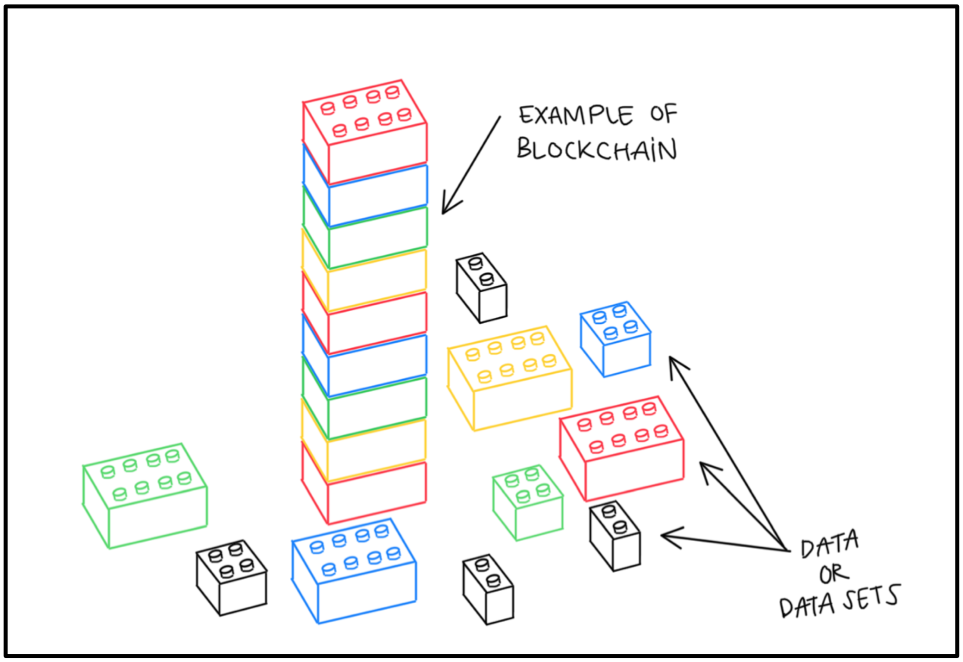

Figure 2. Illustration of Legos, what a blockchain can look like

In Figure 2, I illustrated stacked Lego pieces representing a blockchain, while each Lego piece represents data or data set, creating a channel of information on a blockchain.

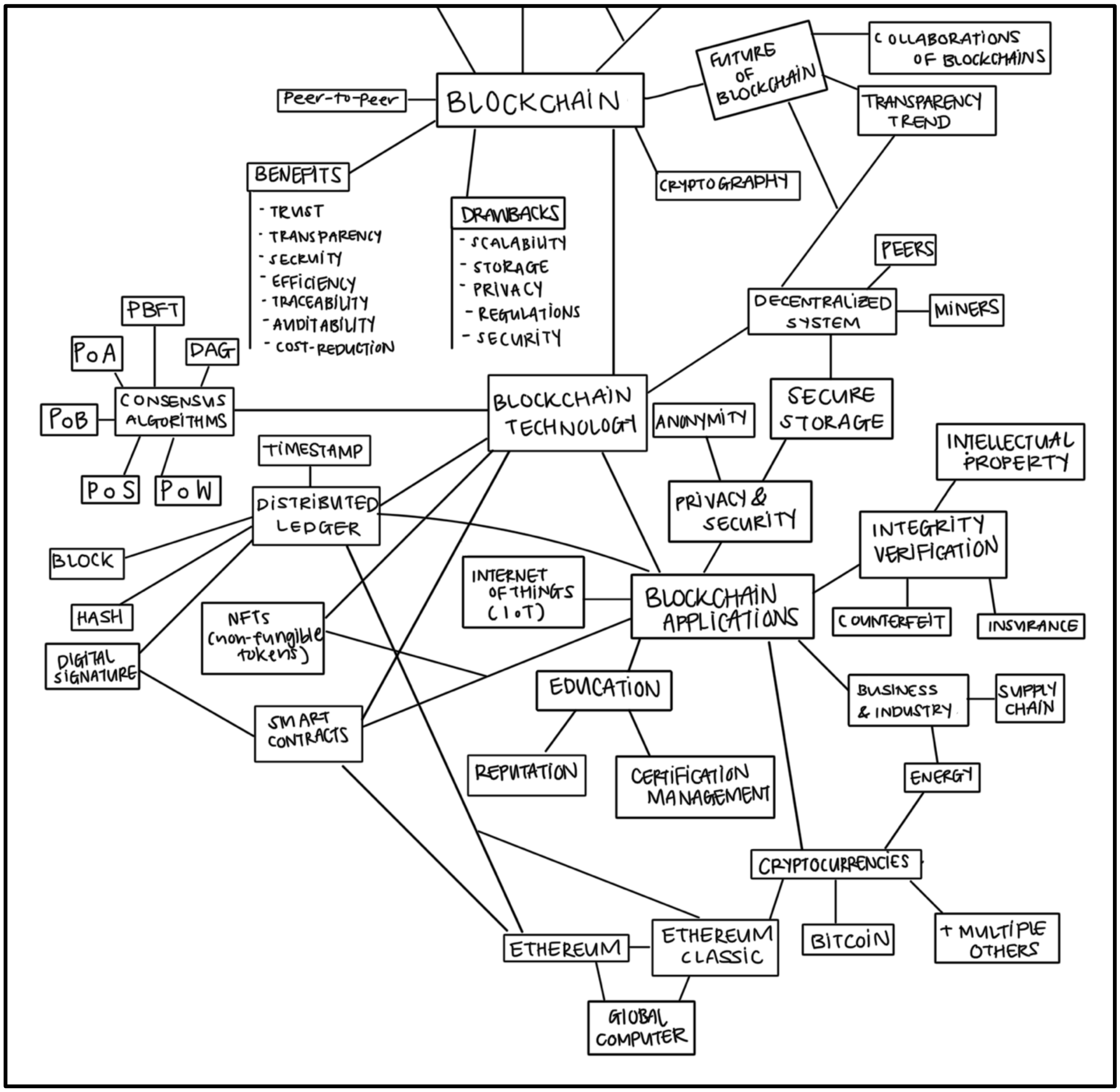

Figure 3. Example illustration of mind-map or concept-map

In Figure 3, I briefly mapped out the interconnection of Blockchain to demonstrate how data sets of a ledger can look. A distributed ledger does not always appear neatly. The lines show where the replicas of the ledger were distributed. In contrast, in a mind map the lines connecting the ideas represent what ideas are associated. Similar to brainstorming, or more so outlining “Blockchain” data is stored (written down), sorted (categorized), and added to the outline or word web (blockchain). Of course, a blockchain is much more complex. However, this is one way of to visualize a distributed network on a blockchain. Another way to visualize a blockchain is a friendship charm bracelet (Figure 4).

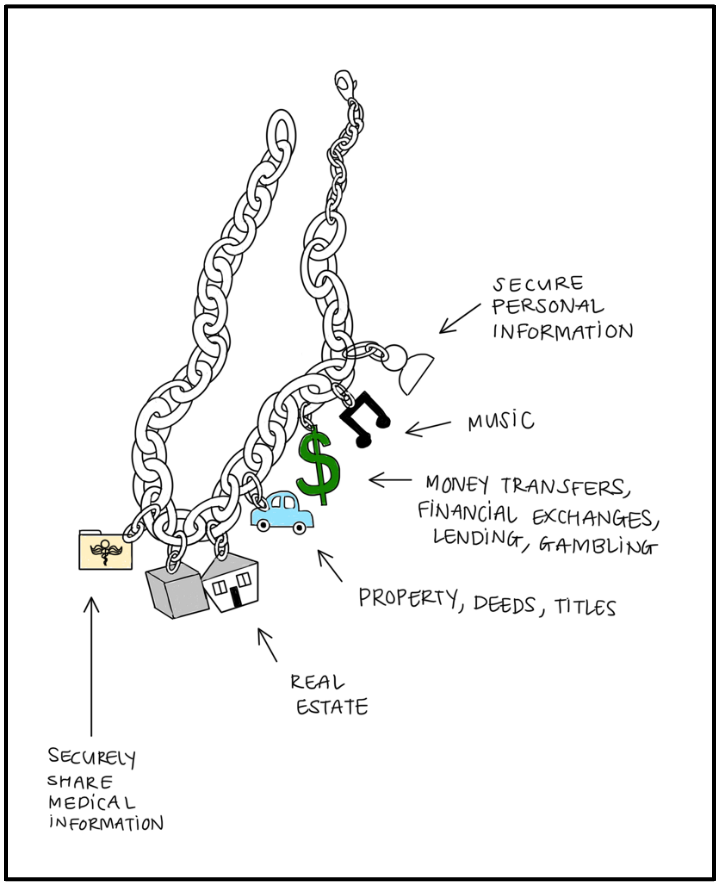

Figure 4. Example illustration of a friendship charm bracelet

Figure 4 shows a friendship charm bracelet with charms representing things you could put on a blockchain such as secured personal and/or health records, real estate, money transactions, gambling transactions, etc. Let’s say a group of friends decided to get matching charm bracelets and set a few rules:

Rule #1: When a friend wants to add a charm, everyone must agree to add the charm.

Rule #2: Once a charm is on the bracelet, it is permanent. It cannot be removed, manipulated, or changed.

Rule #3: Each charm selected and added has to have some connection to the previous charm.

This friendship charm bracelet was a visual collection of charms of their friendship. So, now, imagine each charm the friends received after agreeing to be added to the bracelet is the distributed, replica ledger. Each bracelet looks the same and had the same charms but was a different friends' bracelet. And, the friends agreed, once a charm was added the charm was permanently on the bracelet like immutable ledger records. If a charm were to break or fall off, the bracelet or record would be unaffected. So, in a blockchain the events of the tampered or broken block would be recorded and removed. All transactions on a blockchain are recorded and timestamped and cannot be manipulated or changed.

Christopher Knight (2018) defines Blockchain as "a distributed database that stores a ledger of records and transactions that are immutable once added" (para 2). Blockchain is essentially a database. Traditional databases use a centralized server that can modify and store data. Regardless of how they are programmed "a single authority controls the database and authenticates a client's credentials if they want to access it" (Jason Yanowitz, 2018, para. 19). A blockchain is similar to a traditional database, but what can a blockchain-based database do that a regular database cannot? Nothing. There is nothing a blockchain can do that a regular database cannot do. Some key questions to consider now are: What do I wanted from a database? What qualities of a database are important to me as a researcher? Is it secureness or robustness, disintermediation, robustness, and a fault-tolerant way to store important data from a database? Or is performance and confidentiality a higher priority? The use of databases plays a significant role of in research and data management. Research requires access to various sources and sometimes access can be difficult to obtain. If a researcher has institutional access, depending on the institution, those affiliated will have access to the institution's digital and physical resources, and any department or additional programming available at the institution. However, those who do not have institutional access, how do they receive access to the same kind of research I am using?

During my research project, I had institutional access and often used the GMU library and databases. I had access to several different types of sources, but it wasn't enough. So, I consulted with my professor and a subject librarian and was recommended to look online for open access resources or digital archives. While searching online, I found a significant number of articles that were open access or claimed to be open access, but would be missing a large chunk of pages. There were also a few floating works known as grey literature. Grey literature "consists of materials that are unpublished or have been published outside of the typical commercial or academic publishing environment" (Pollack Library); examples include conference proceedings, graduate theses or dissertations, PowerPoints presentations, unpublished clinical trials, government reports, etc. Grey literature is essentially the work that is considered the "grey area" of standard academic library and publishing practices. Although, it can be very helpful for understanding and establishing research topics, collecting grey literature may be more invaluable to include in research due to the variety of sources produced but not properly catalogued or organized, often makes it difficult to retrieve and locate these types of sources. So, I was wondered how people should properly conduct research from home if they were not affiliated with an institution that had the privilege and funding to require access? Research should be open to all, because the articles, case studies, books, etc. I read from GMU's library website is completely different from the books I would take home from the public library. And, as a graduate student I do not get paid enough to pay hundreds of dollars to multiple database subscriptions. I solaced my curiosity and started considering if there were other resources that collectively housed open access materials, both primary and secondary sources. But to my dismay, there weren't that many options. There were organizations like Project Gutenberg or the Directory of Open Access Journals (DOAJ), but I wanted something more. It wasn't just wanting to know the other options and resources available, but also providing access to fellow researchers who were never affiliated or are no longer affiliated with an institution.

This was about the time I was curious about the digital humanities, cryptocurrency, and blockchain. Blockchain always seemed like a lucrative concept, and it took me a while in order to fully understand what Blockchain was, and even longer to explain it to others. But, Blockchain is rather simple when you think of it as a permanent digital record, and then it starts to become complex again because of its beginnings and inspirations. Blockchains are "a way to store data in a decentralized network of computers," but are also "the technology built off the backs of thousands of years of philosophy, mathematics, cryptography, and computer science research" (Knight, 2018, para 5). The core of blockchain technology is its immutability and reliability, or as Kevin Werbach (2018) explains, "at its core, Blockchain is trusting a system without trusting any of its components. A blockchain network allows participants to trust the information recorded on a shared ledger without trusting anyone to validate it. And no one—not an owner, not an exchange, not even the government—has unbridled power to stop or alter transactions on the network" (p. 3). It is essentially an entrusted system supportive of the concept of "good Samaritans." The combination of the blockchain hashing process validating transactions and cryptography makes blockchain immutable. And due to its immutability, it is a reliable and protected system of recording information, which makes it difficult or almost impossible to change, hack, or cheat. Therefore, if I were to trust you and you were to trust me, we would agree that we trusted each other and our transaction would be approved, recorded, and immutable.

Centralization vs. Decentralization

Blockchain seemed like a good start, because it is a trusted ledger system, but what sold me was how blockchain is a decentralized, distributed ledger system. However, in a centralized network there is a central authority that governs and manages the network. Therefore, transactions must be approved through a third party such as a financial institution, or "middleman", or intermediary. However, it is not 100% trustworthy. In a centralized network, there is a single point of failure (SPOF), which affects the network's security, causing the network to be vulnerable to hackers or security breaches. Having a single point of failure in any system is a risk. One malfunction can cause an entire system to stop working. Take WIFI routers for example. A service provider's servers could be operating normally, but if the load balancer malfunctioned, the Internet router would not properly receive service, causing all systems to shut down or improperly function. A centralized network also has higher exchange fees, is user friendly, and users' profiles are not anonymous. Its central authority control stays with the user.

Blockchain seeks to provide a more efficient and effective approach to disintermediation, by enabling a decentralized system of currency, digital contracts, and virtual asset control. Decentralization enables participants to manage their own assets. Although, it is not user friendly and expensive to setup, a decentralized network does not use a third-party, which means lower exchange fees, high security abilities, immutable data, and is anonymous. It is also reliable, because transactions processed through a blockchain are transparent. Meaning all transactions and interactions are visible to everyone. Transparency eliminates bias when companies claim there are no "serious issues." A blockchain is secure because a decentralized, distributed ledger is duplicated in multiple locations. So, by spreading multiple records across a network, open to all to view, it is essentially hacking resistant (HBUS, 2018). Although transactions can be found on the ledger, mapping the public key to the encrypted private key (further explained later) is nearly impossible (HBUS, 2018), which makes a blockchain very secure.

Private vs. Public Blockchains

Network participants can access records using a block explorer to find relevant information, but not all blockchains are public. There are both public and private blockchains. Blockchains are different, and the public blockchains most companies use are different. Public blockchains are permissionless and anyone can join the network. Public blockchains are also decentralized, and data on a public blockchain is secure, because it once the data is recorded and approved—it is unchangeable. Private blockchains have a different level of security, thus "companies, and specifically, groups of non-trusted parties, will utilize what are called private blockchains. In private blockchains, there is a control layer built into the protocol, which allows for network participants to have control over who can join the network and participate in the consensus process […] private blockchains have a select group of companies and organizations that can becomes nodes" (Jason Yanowitz, 2018, para.17). Private blockchains are permissioned blockchains and work based on access control. Both private and public blockchains cannot alter or delete records once the validity of a record is verified. They both require numerous users to help authenticating records who receive a complete replica of the ledger.

Peer-to-Peer

Blockchain is a peer-to-peer (P2P) network. P2P is two or more personal computers connected, sharing resources without a server computer like Napster. In the late 90s, Napster was the first widely known P2P program that allowed users to download mp3 files from a network of other user's computers. This type of technology paved a path to clearer avenues of digital downloads, such as BitTorrent technology, which splits media files into several parts. By downloading a .torrent file, a user holds a 'manifest' or 'receipt' of various IP addresses of download locations for each piece to produce the file

(Knight, 2017, para 8). A blockchain offers a single version of truth, so, similar to Napster, a replica copy of a ledger is sent to a network of computers (nodes). It was a combination of different influences such as P2P, digital currencies, and cryptography that structured blockchain.

Cryptography

Cryptography is the practice and technique Blockchain uses dates to the Ancient Greek terms Kryptos and Graphein meaning “hidden” and “to write” (Sahu 2022). Cryptography was originally used to prevent the public or third parties from reading messages during wartime. There are several types of cryptographic algorithms, such as: symmetric-key cryptography, asymmetric-key cryptography, and hash functions. Symmetric-key cryptography, also known as secret-key cryptography. It is an encryption method that uses one key to both encrypt and decrypt, causing issues between securely transferring the key from user to user. And, it depends on the strength of the random generator used to create the secret key. However, compared to asymmetric-key cryptography is symmetric-keys are much faster. Asymmetric-key cryptography, also known as public-key cryptography, creates a pair of keys: one specifically for public use and one for private use. Though they provide more protection and security than symmetric-keys, the caveat is that it is slower. Lastly, hash functions or hashing algorithms, do not use keys at all but instead use a cipher to generate a hash value, which makes it nearly impossible to recover plain text from the ciphertext. Blockchain uses asymmetric-key cryptography and hash functions which allow it to be open and transparent.

Hashing

Key cryptographic terms like hashing, public and private key, and immutability help enable Blockchain technology. Hashing is data encoded into a hashed sequence of letters and numbers. Hashing is meant to help validate transactions, while encryption is meant to maintain confidentiality. Hashing is designed to efficiently find or store an item in a collection. For example, if we have a list of 10,000 business contacts and need to find if a particular contact is among this list, how inefficient would it be to compare all 10,000 contacts to find one? Even if the business contacts were lexicographically sorted, similar to a dictionary or encyclopedia, we would still need to spend time looking through the list to find this single contact. Hashing helps narrow our search, generating an index whose value is stored using an algorithm or function to map object data to some representative integer value, or a hash code/hash value.

Public or Private Key

In Blockchain, "the public key is used as the address of the person" (Sasu 2021), which is visible to the entire world. While, "the private key is a secret value and is used to access that address data and authorize any of the actions for the 'address'" (Sasu 2021). A public or private key is used to encrypt and decrypt data. The public key is used to encrypt, while the private key is used to decrypt. It is common for users to publish public keys and keep private keys to themselves, which allows the user to disclose different or select data on a transaction. For example, it is similar to sending information-sensitive emails, those emails that you do not want anyone else to read by mistake. If I wanted to send an encrypted email to a coworker, I would use their public key to encrypt my message to my coworker. For my coworker to see the encryption, they must use the private key, which is only known to them, to decrypt the email. Although our organization may have access to the server and can try to read the message, they will be unable to read the message because they do not have the private key to decrypt the email. If my coworker wanted to reply, they would do the same thing by searching my public key and sending me an encrypted message. Public and private keys can also be used to create digital signatures. Digital signatures ensure that the person who is sending or receiving is who they claim to be. But any data entered must be authenticated and protected and depending on whether blockchains are private or public will constitute different protocols of accountability.

Once a transaction is entered in the blockchain and recorded in the ledger, the records cannot be changed because they are essentially linked to every previous record; thus, the records are considered immutable. Blockchain's ability to record is so cherished because it can keep a stable record of everything of value including investments, property-deeds, content ownership, energy usage, votes, supply-chain, micro-payments, gambling bets, etc. (Knight, 2017, para 15). Together, hashing, public and private keys, and immutability contribute to Blockchain's development.

Digital Currencies

All online transactions use digital currency. Once money is withdrawn from the bank or ATM, the money withdrawn gets transformed into liquid cash. Digital currency is the electronic form of fiat money that can be used in contactless transactions. Fiat money is a type of currency issued by the government such as the U.S. dollar, the euro, or pound. Its value is what the government guarantees as legal tender, whereas gold is an example of commodity money, which is the money in physical goods that have value or intrinsic value. Other examples of commodity money would be alcohol, copper, salt, silver, tobacco, etc. Digital currencies provide equality of opportunity by creating unique opportunities for economic freedom globally.

Cryptocurrency

Cryptocurrency or crypto has a decentralized and unregulated value that is secured by encryption. Cryptocurrency rates can be highly volatile and are currently not widely accepted. Although, some companies have begun implementing the option, people wouldn't be able to use cryptocurrency at a mom-and-pop shop just yet. Cryptocurrency is decentralized, meaning they are not issued or controlled by any government or other central authority, but verified by P2P networks and use a blockchain. It also eliminates any intermediators, such as banks, clearinghouses, or payment processors, allowing a user to transfer money globally, with low fees, and almost instantly. Some other benefits of cryptocurrency are how it is easily transferable at a low-cost versus traditional banks transfers, and is portable because crypto is not tied to any financial institutions or governments. Cryptocurrencies are private because by not having to share unnecessary personal information, our privacy is more secure than by having to share any personal information. It is also secure and irreversible, because it is constantly checked and verified. Transactions made cannot be reversed, which lowers the risk of fraud, especially on an open, transparent platform (coinbase.com). Although digital currencies do not need to be encrypted, users must secure their digital wallets and banking apps, which relies on a strong password and biometric authentication to minimize hacking and/or theft. Cryptocurrencies are protected by utilizing strong encryption. In order for users to be able to trade crypto, users need to have a usable bank account that already has money in it, so this digital currency can be exchanged through an online exchange to receive the corresponding crypto value. Cryptocurrencies are also backed up using a blockchain. Though it is unregulated by a central authority, all transactions are recorded and available for all to see. Although digital currency is easier to use and more familiar to users, cryptocurrency wants to create an even easier and faster local and global transactions, returning the power and responsibility back to the currency holder's hands. Digital currencies can provide equal opportunity by creating unique opportunities for global economic freedom; wanting to create even more opportunities for global economic freedom.

Miners

A large part of blockchains are miners or maintainers. Miners cycle power using their own computational resources to run the blockchain hashing code needed to encrypt new data into a blockchain—maintaining the blockchain's information. Each node, or computer that runs the cryptocurrency software earns rewards for doing the computational work of verifying the legitimacy of a transaction. When "mining," miners use sophisticated hardware, such as a graphics processing unit (GPU) or an application-specific integrated circuit (ASIC), to setup a mining rig to solve complex hashing puzzles, or computational math problems; earning cryptocurrency without having to invest (Euny Hong, 2022). So, if the ledger increases, the amount of computing power required to add and verify transactions increases. This is due to the difficulty of solving the hashing puzzles and processing the amount of information each ledger contains. The bigger the file, the more time involved, and the larger the share of profits. So, in other words, miners are like auditors paid with cryptocurrency.

Blockchain enables a data set to be stored without a central server. The data is encrypted, and copies are distributed throughout the network of computers. This ensures that each blockchain 'node' has a copy of the ledger, which makes it much more difficult to attack than a single data source or centralized network (Knight, 2017, para 20). Therefore, blockchain technology is secure in the sense that the amount of electricity and processing power someone would need to control a blockchain is infeasible unless it is part of a large government. Miners work to understand and decrypt transactions processed through a consensus process.

Proof of Work vs. Proof of Stake

There are various consensus algorithms in the blockchain space. However, the two most popular consensus algorithms are proof of work (PoW) and proof of stake (PoS). A consensus algorithm is a decision-making process for groups to contrast and support the most suitable solution. A protocol is the rules of the blockchain for things like how the network nodes interact, transmit and verify transaction data. David Lee Kuo Chuen and Linda Low (2018) state: "To achieve the purpose of decentralization, a public blockchain commonly has its own intrinsic token with the main objective being an incentive to reward honest users who participate in the consensus process and help to maintain the integrity of the blockchain state" (pp. 207-208). So, a proof of work algorithm will challenge and incentivize miners, or participants of the network, to solve cryptographic puzzles or hash functions in order to receive a reward for verifying transactions. The disadvantage of a PoW is it requires special hardware to mine and works at lower speeds, which is not suitable for everyday use.

Whereas, a proof of stake algorithm randomly selects miners according to their "stake" in the network with knowledgeable consent, so that they will not receive a reward and receive only transaction and network fees. It is low in cost and power consumption because no hardware is needed. It is high in speed and can be used on an everyday basis. A PoS can limit the power of miners by replacing computational power with the tokens at stake. However, a PoS could promote a different type of centralization, allowing large stake holders to have more power over a cryptocurrency's development (Werbach, 2018, p. 121). A PoW algorithm relies on computational power, which feels similar to a competition or race. Whereas a PoS algorithm randomly selects miners by stake in the network and relies on currency power. Though these are the most popular consensus algorithms used, there are other options available such as a proof of authority (PoA) [uses identity as a stake] or proof of capacity (POC) [based on the amount of memory or disk space] or proof of space (PoSpace) [based on disk space or storage being used]. Not all blockchains are created the same and has different set of protocols and algorithms.

The Drawbacks

There are different types of blockchains, which may influence the privacy or level of security of the network. However, they are still blockchains, which means they are still decentralized, distributed ledgers that are immutable. Some of the limitations of blockchain technology are due to its scalability, storage capabilities, inconsistencies with privacy and security, and any current conflicting regulations. A blockchain relies on the management of the network, so everyone in the network has access to the data. But there is always the possibility to track down the identity of a person through transactional data like how businesses use web trackers and cookies. In Satoshi Nakamoto white paper they released around 2010 stressed the "51% attack," where if 51% of the nodes in a network lied, the lie will have to be accepted as the truth. Therefore, everyone in the network would have to continually watch for any unwanted, overlying influence(s). If there were a case of fraud, the platform would need to demonstrate and elaborate the identity of the perpetrator and provide an explanation of identifying who it was. But also, explain any other underlying conditions that could have contributed the perpetrator to resort to fraud. Basically, this means the platform must advocate for themselves and if unable to properly do so, the network would be at a loss. Since it is a decentralized network there is no customer service, there is no one to complain or empathize with. Therefore, blockchains are not 100 percent secure, private, or regulated, but the technology is constantly improving itself (Maruti Techlabs, n.d.).

The Evolution of Blockchain

There have been three stages Blockchain:

- Blockchain 1.0: Cryptocurrency
- Blockchain 2.0: Smart Contract-based ledgers
- Blockchain 3.0: Next Phase of DLTs

I will start by discussing Blockchain 3.0. This stage in Blockchain is the incorporation and expansion of blockchain technology, or the continuation of blockchain technology. Some say blockchains have reached its peak, and as a technology it is ‘complete’. However, there is so much more that can be done, especially when incorporating blockchains with other types of technology.

In Blockchain 1.0: Cryptocurrencies utilize blockchain technology. Bitcoin is the world’s first fully decentralized cryptographic financial network to publicly use a blockchain database and a concept called scripted money. Scripted money is “the idea that cryptocurrency transactions could transmit funds depending on the true/false status of running a limited program” (Lorne Lantz and Daniel Cawrey, 2021 chpt. 4, n.p.). Essentially, approaching Bitcoin as what Lantz and Cawrey describe as limited “programmable money.” Bitcoin is digital money that allows secure peer-to-peer transactions on the Internet. A mysterious, pseudonymous person named “Satoshi Nakamoto” launched the “genesis block,” or the first entry/block in Bitcoin transactions around 2009 (Timothy Lee, 2014). Due to the size of its usage, Bitcoin is the most valued market traded coin in cryptocurrency to date. Bitcoin has simultaneously brought an enormous amount of attention to cryptocurrency and began to hold much more value. However, due to its limitations, it became a disruptive topic of debate whether it was just a currency or stored more value. In order to address the limitations of Bitcoin, developers began to resolve issues with scalability, which introduced colored coins and tokens.

Although limited in scalability, Bitcoin’s blockchain can store small amounts of data or metadata. It was the incorporation of concepts from DLT and Ethereum that inspired tokenization. Tokenization is programming assets into digital units of value recorded on a blockchain. Bitcoin uses *colored coins* built on top of the Bitcoin blockchain, which “enable real-world assets such as equities (e.g., stocks) or commodities (e.g., gold) to be represented and managed on the Bitcoin blockchain” (Lantz and Cawrey, 2021, chpt. 4, n.p.). Colored coins further inspired the concept of tokens or tokenization, "Tokens were foundational to the development of Ethereum’s ecosystem, and the advent of colored coins on Bitcoin led to tokens on other blockchains” (Lantz and Cawrey, 2021, chpt. 4, n.p.). Tokens are special virtual currency that represent fungible and tradable assets or utilities that have and are on their own blockchain—or *crypto assets*. Tokens are assets where the ledger(s) are built on top of an existing blockchain used to invest, store value, or make purchases. Ultimately, tokens helped improve Bitcoin’s scaling issues and eventually led to the development of other blockchains.

Which leads us to Blockchain 2.0: the rise of another prominent example of blockchain technology, Ethereum. Ethereum was first proposed in 2013 by Vitalik Buterin, a 19-year-old computer programmer, who released a “whitepaper proposing a highly flexible blockchain that could support virtually any kind of transaction” (coinbase.com). The founders of Ethereum wanted to build a global, decentralized computing platform, inspired by the security and openness of blockchains. Essentially, the collection of multiple, individual computers running Ethereum software contribute to a giant, global computer, or ‘virtual machine’. Ethereum was also the first cryptocurrency to execute smart contracts on a blockchain to “allow developers to build complex applications that should run exactly as programmed, without downtime, censorship, fraud, or third-party interference" (coinbase.com). Smart contracts are engines that allow blockchain-based systems to support more than digital cash, "smart contracts, running on a blockchain platform, took the place of law, intermediaries, and personal relationships as the foundation of trust" (Werbach, 2018, p. 67). Nick Szabo (2018) demonstrated how smart contracts were similar to vending machine transactions. Vending machines are an example of peer-to-peer exchange transactions. So, when a customer goes to a vending machine to purchase a soda, there is already an established understanding once I (the customer) pay for the product, the product will then be dispensed by the business (the vending machine), which then completes the transaction. A smart contract is similar to a vending machine transaction, because it is a self-executing contract with the agreement between the both buyer and seller, guaranteeing both parties will complete the transaction appropriately.

Around 2016, Ethereum encountered a significant drop in its currency amid an apparent security breach, targeting an organization's large holdings. A hacker took advantage of a bug in DAO, the Decentralized Autonomous Organization, code through a series of smart contracts. Ethereum originally used a decentralized system of smart contracts following the PoW consensus algorithm, similar to Bitcoin, and designed its own hash-like algorithm "Ethash." It was initially undetected because the hacker went through the network as smart contracts, which followed the smart contract protocols to infiltrate DAO's holdings. Resulting in the launch of Ethereum 2.0 in 2021, to improve issues with increases in fees, electrical power consumption, bottlenecks or demand spikes. Both the first design, Ethereum, now known as Ethereum Classic, and Ethereum 2.0 coexist today. However, Ethereum 2.0 follows the PoS algorithm, which is much faster, more secure (theoretically), and uses less power when running its program. Werbach (2018) explains as "I may trust you, and you may trust your bank, but that doesn't mean I trust your bank" (p. 72). The DAO incident revealed that a blockchain does not eliminate the need for trust, but that "trust is confident vulnerability" (Werbach, 2018, p. 72). Thus, Ethereum 2.0 quick improvements helped solidify the trust in Ethereum's immutability.

DApps

Even after a security breach and a great loss in funds, Ethereum strengthened their networks' trust by providing an upgraded version, while keeping the original, Ethereum Classic as well. Ethereum was the shift from the initial beginnings of cryptocurrency and further development of the limitations observed and adapted from Bitcoin's blockchain. Another large part of Blockchain 2.0 or Ethereum are dapps or decentralized applications. Dapps are any computational program that runs on a smart contract platform, such as Ethereum, which is the largest smart contract platform. They are blockchain-based applications versus regular applications. People use applications every day, but the issue with regular applications is they misuse data, potentially sell information, and risk leaking the information. Application users could potentially be stuck or forced to use an app due to expensive or impractical cancellation methods (e.g., health trial subscription). Or, depending on the app, users can be censored and monetized for their activity on the app such as Instagram or TikTok.

Though they are still developing, dapps are secure, transparent, and resistant to censorship. DApps are decentralized, which means users are no longer prevented from using apps in different regions or restrictions. On a decentralized blockchain network, there are millions of nodes that hold a backup copy of the dapp. And, because it is run on a smart contract based blockchain trust is no longer a requirement but programmed in. Dapps are also open source and transparent, which means anyone can view the inner workings of the application, and the app is honest about any bugs, risks, updates, changes, etc. Though, my project is not about cryptocurrencies, Ethereum, dapps, etc., it is important to understand the fundamentals that have influenced the foundation of blockchain technology. In order to accept the potential blockchains have and how to implement blockchain into the humanities with concepts, such as color coins, tokens, dapps, etc., have developed other features like NFTs, or non-fungible tokens.

NFTs

Concepts related to blockchain technology such as color coins, tokens, dApps, etc. have contributed in the development to other features such as NFTs or non-fungible tokens. So, what are non- fungible tokens? What is the difference between fungible and non-fungible? How can this involve the humanities? Fungible items are exchangeable goods such as gold, silver, oil, and grains. Non-fungible items are special, specific goods such as a painting, a specific heirloom, or bejeweled egg. Thus, physical money, digital currency, and cryptocurrency are fungible, meaning they are exchangeable. For example, if I let you borrow and dollar, you owe me a dollar. If we exchanged Bitcoin, one Bitcoin is the same price of one Bitcoin; however, NFTs are different.

Non-fungible tokens are digital assets that represent real-world objects such as art, music, videos or clips, game items, etc. Each NFT has a digital signature that enables an exchange or be considered equal to the exchange value. NFTs are basically collecting items in a digital space. I like to think of NFTs like a collector's area in an office but set in the game, Sims. In an office, you may keep important documents about properties you own, personal documentation, artistic work of your own, etc. but you may also hold items of value (non-fungible tokens) such as artwork, collectibles, etc. An NFT can have only one owner at a time, managed through the smart contracts that assign ownership and transfer NFTs. So, if you own an NFT it is easy to prove you are the owner, no one can manipulate the NFT, and you have the power to sell or hold on to it forever in your digital wallet. If you create or mint an NFT it is easy to prove you are the creator, you as the creator can determine the scarcity of NFTs created, can earn royalties every time your work is sold and if the new owner resells your creation, and you can sell on other platforms besides only NFT or P2P platforms. The value of an NFT is similar to purchasing art pieces. It is entirely based on what someone else is willing to pay for it, meaning demand will drive the price. And even by the third evolution of Blockchain, blockchain technology continues to learn and develop its technology. It is the incorporation of other technologies like AI that strengthen its limitations and reciprocate its own strengths in creating an almost flawless system.

There are so many components to blockchain, but it is essentially an innovation in keeping track of our own information, whether users or researchers choose to use it solely to keep records or for cryptocurrency. Blockchain technology supports users taking control of what is their own.

CHAPTER FOUR: THE "ART"-IFICALLY INTELLIGENT

In this chapter, I provide an overview of artificial intelligence (AI) in order to build a basic understanding of AI. This is to demonstrate the reciprocal relationship between AI's and Blockchain's potential of effective research practices in literary studies. This chapter does not provide an entire demonstration of the field of AI, but the beneficial support Artificial Intelligence and Blockchain offers one another through examples similar to literary studies. By utilizing AI with Blockchain, Artificial Intelligence helps to improve the insufficient features of Blockchain such as security, privacy, overall trust, and data management.

An Overview of Artificial Intelligence

There is significant value in Blockchain and AI separately, so as the technology continues to develop, these reciprocals technologies can support one another and overcome the limitations of both emerging technologies concerning Blockchain's issue with power consumption, and security, privacy, and transparency issues. Artificial Intelligence and Blockchain can work seamlessly together to support each other's limitations resulting in a "decentralized intelligence system" (Aisha Wahaibi and Manju Jose, 2020, p. 3). Artificial intelligence is the idea of building machines capable of thinking like humans. But, when people initially think of AI, they usually assume robots. However, the initial conception of artificial intelligence can be traced to Alan Turing's (1950) "Computing Machinery and Intelligence" which asks, "Can machines think?" and suggests that machines could be intelligent. The term artificial intelligence was coined by John McCarty, Marvin Minsky, Nathaniel Rochester, and Claude Shannon at the Dartmouth Summer Research Conference on Artificial Intelligence in 1956. On McCarthy's website, he defines AI as "the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable" (n.d., para 1). Artificial intelligence research aims for machines to work and behave like humans; however, this is not to be confused with AI becoming human, but for AI to think and behave *like* humans.

'Artificial' represents mimicking how humans think and act, while 'intelligence' is not an especially well-defined term. For example, there isn't an IQ test that holds up across human cultures let alone different species. Therefore, there is no concrete definition of intelligence because "we cannot yet characterize in general what kinds of computational procedures we want to call intelligent. We understand some of the mechanisms of intelligence and not others" (McCarthy, n.d., para 3). However, McCarthy defined intelligence as "the computational part of the ability to achieve goals in the world. Varying kinds and degrees of intelligence occur in people, many animals, and some machines" (n.d., para 2). Intelligence can be the ability to solve complex problems in complex environments. But the term 'intelligence' cannot be easily defined because it is circumstantial. Understanding intelligence as the ability to solve complexity in complex circumstances offers room for interpretation. 'Artificial' and 'Intelligence' work together as an umbrella term that establishes an emerging decentralized intelligent system.

Artificial [Narrow, General, or Super] Intelligence

Artificial Intelligence is the largest and broadest term of the science of getting machines to mimic the behavior of humans. AI consists of three main categories: artificial narrow intelligence (ANI), artificial general intelligence (AGI), and artificial super intelligence (ASI).

ANI

Artificial narrow intelligence, also referred to as "narrow AI," consists of weak AI that is trained to only perform specific tasks. Weak AI lack self- consciousness and are limited in its learning abilities. Their functions are based on a combination of preexisting data and logic (Ganesh Kumble and Anantha Krishnan, 2020, chpt. 1). A few examples of AI applications that have a weak AI are Amazon's Alexa, Hanson Robotics 'Sophia,' and the routing function in Google Maps. These applications have a small range of specific tasks they can perform and have no self-awareness, -consciousness, or the ability to think. In literary studies, an example of an ANI researchers would be familiar with are citation tools like scite.ai. scite.ai is fairly new but is an "Artificial Intelligence enabled took that seeks to go beyond citation counting to citation assessment, recognizing that it's not necessarily the number of citations that is meaningful, but whether they support or dispute the paper they cite" (Elizabeth Gadd, 2020, para. 1). Scite.ai seeks to identify where citations are 'supporting' or 'disputing' and is one of the many other citation-based and evaluation tools available to researchers such as Semantic Scholar. Semantic Scholar is also a free, AI- powered research tool for scientific literature that utilizes AI and machine learning to find patterns, and natural language processing to ‘read’ the text to identify where a paper is ‘influential’ (Gadd 2020).

AGI

Artificial general intelligence, or “general AI,” consists of strong AI that allows AGI to be almost as smart as humans. Strong AI are perceptive and conscious of problems and can resolve issues. Their functions can be used for aggressive learning to expand abilities. AGI involves machines that possess the ability to perform any intellectual task that a human can like the ability to learn, generalize, apply knowledge and the ability to plan for the future. Although it has not been fully achieved developers continue to question its possibility.

ASI

Whereas Artificial super intelligence, also referred to as “superintelligence,” consists of strong AI; ASI is theorized to be smarter than the best humans. This is a hypothetical ability of a computer to surpass human thinking. Although they are nonexistent, developers coincidently prepare for a drastic jump from AGI to ASI. ASI is also the type of AI most commonly seen in films and TV shows (Eda Kavlakoglu, 2020, para. 21-22).

Deep Learning, Machine Learning, and Neural Networks

People misunderstand the difference between AI, machine learning, neural networks, and deep learning, and assume they have the same meaning. Though they are similar, they all are separate concepts that are related to one another. In Figure 5, IBM provided a useful illustration of Russian nesting dolls that demonstrates how AI, machine learning, neural networks, and deep learning are all separate concepts but interconnected with one another. Each doll appears to look similar but are different and can reside inside the previous doll and retain another smaller doll inside itself, gradually getting smaller and becoming one set of dolls encased in the largest doll. In this case, the largest outer doll represents AI, while the inner counterparts (going from the outer most layer to the inner layer) would then be machine learning, neural networks, and deep learning. The Russian dolls represent the interconnection of AI to machine learning to neural networks to deep learning.

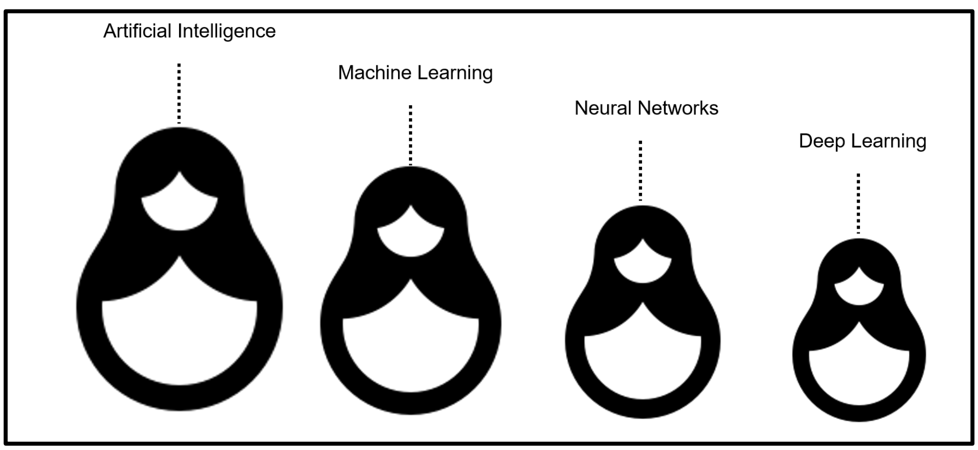

Figure 5. Image from IBM.com. Russian Doll example.

Machine Learning

Machine learning is a way to use Artificial Intelligence. It eliminates the need to write down detailed instructions for every single problem in a manual or directions guide, and instead teaches machines a general set of instructions that allows machines to learn from experience, usually by analyzing data (Malone, 2020, p. 6). So, more data means a more effective program. According to Malone (2020)

> …machine learning refers to a process that starts with a body of data and then tries to derive rules or procedures to explain the data or predict the future data. The function of a machine learning system can be *descriptive*, meaning that the system uses the data to explain what happened; *predictive*, meaning the system uses the data to predict what will happen; or *prescriptive*, meaning the system will use the data make suggestions about what action to take. (p. 6)

However, machine learning techniques can have a limited ability to process data and require programmers to provide guidance. Machine learning has three subcategories: supervised, unsupervised, and reinforcement machine learning. Unsupervised machine learning "looks for patterns in unlabeled data" and 'can find patterns or trends that people aren't explicitly looking for" (IBM, para. 19). It is also known as clustering or grouping and is the process of learning without having any training labels. Reinforcement machine learning "trains through trial and error to take the best action by establishing a reward system" (IBM, para. 20). It is the process of learning from an AI's behavior in an environment through feedback like how children learn to walk. Children will continue to stumble and fall, but gradually learn to balance themselves until they have learned to walk.

Humans are not born with many skills. We must learn how to sort mail, tie our shoes, and even conduct conversations, etc. So, to help humans, computer scientists have helped computers learn the way we do with a process called supervised learning. We encounter supervised machine learning on a daily basis, such as our emails. Emails can classify which messages are important and what is spam mail. Supervised machine learning models are the most common type and are "trained with labeled data sets, which allow the models to learn and grow more accurate over time" (IBM, para. 18). It is the process of learning with training labels. Meaning, like its name, there is some supervision when a machine is fed data.

Essentially, how supervised machine learning works is we have some data sets that we want to input because we have some kind of objective, we want the AI to do. To set the scene, let's say I owned a company that resells vintage t-shirts online and I simply wanted the AI to classify if a t-shirt is a t-shirt. In supervised machine learning, I could hold up a variety of shirts as the AI would try and distinguish if what I was holding were t-shirts or not—while adjusting and correcting the AI the answers. Also, keeping in mind of the AI's precision and recall; precision determines the level of trust in the AI, while recall determines the level of the program's ability to find what you're looking for. A perfect AI would be small, powerful and have perfect precision and recall, but realistically it is adjusting the criteria appropriately to determine the best route to success. However, it wasn't until 2012, where the winners of the ImageNet Large-Scale Visual Recognition Challenge changed AI by taking machine learning model called neural networks in combination with using deep learning techniques it started to outperform other machine learning models, creating a new, efficient model and further popularizing deep learning (Emerging Technology from the arXiv, 2014).

Natural Language Processing

AI has been able to understand commands and highly structured programming language such as Python and Java. However, humans do not use Python and Java to interact but use “natural languages” like English, Spanish, and Chinese, which is challenging to program. Natural language processing (NLP) is focused on understanding and generating human languages and “includes automatic text parsing and understanding, speech recognition, machine translation between human languages, text generation, text summarization, and question answering” (Malone 2020). NLPs are commonly used at call centers because they are able to dictate callers’ requests into text and then identify the nature of callers’ requests; while the more complex is directed towards a human representative. There are two main phases to NLP: data preprocessing and algorithm development, which basically prepare text data in order for machines to analyze it. NLPs are also used for text classification, text extraction, translation, etc. Some examples researchers would be familiar with are word processors that check for plagiarism and proofreading like Grammarly or Microsoft Word, or even automatic translators like Google Translate.

Neural networks

Neural networks, artificial neural networks (ANNs), or even simulated neural networks (SNNs) are a sub-section of machine learning and sub-sub-section of deep learning, which extensively influence deep learning. Neural networks emulate the activity of the human brain; hence “neural” as in neurons. This allows computational programs to recognize patterns and solve common issues in Artificial Intelligence, machine learning, and deep learning. A neural network consists of four parts: inputs, weights, biases or thresholds, and outputs, which help to predict the value of a variable based on another variable. The variable you want in the dependent variable and the one you use to predict is the independent variable. So initially, we did not let the computer do all the learning itself but would do the majority of the work ourselves and supply the information to a machine learning model.

Deep Learning

Deep learning is a subfield of machine learning. It is comprised of neural networks that solve complex problems. 'Deep' machine learning is a type of supervised learning; however, it does not require a labeled dataset. Yann LeCun states "Deep- learning methods are representation-learning methods with multiple levels of representation, obtained by composing simple but non-linear modules that each transform the representation at one level (starting with the raw input) into a representation at a higher, slightly more abstract level" (p. 436). A machine could be fed raw data and automatically distinguish significant elements to differentiate the data from each other. The "multiple levels of representation" is what differentiates deep learning and machine learning. Deep learning is programmed to learn patterns with or without help.

Artificially Intelligent Blockchain Tech

By integrating the two technologies, Artificial Intelligence with blockchain, can help supplement limitations and help achieve each other's goals. Artificial Intelligence can use AI algorithms to analyze data and calculations; supervise networks; identify specific patterns; able to simplify workflow; reduce human error; and provide better billing and coding methods. Whereas Blockchain is a database and has data availability, data access, and can share; validate data and secure storage; enable devices to communicate directly; utilizes and records on a ledger; can track devices; is the basis for applications involving transactions and interactions (Aisha Wahaibi and Manju Jose, 2020, p. 4). Although they provide a well-integrated and well-balanced system, they are still two separate technologies where they can support themselves.

Gradual Improvements in Power Consumption

Blockchain is not as user friendly as I would like or hope it to be. It can be technically and computationally dense. However, it is a developing technology and continues to make improvements to its programs. Although, in literary studies, researchers may still stray away from using especially if they care for the environment. However, if researchers were resistant in implementing Blockchain in the humanities because of the high- cost in purchasing hardware or the computational power needed to run its program, Blockchain with AI provides the assistance.

Blockchain uses a significant amount of computational power, which Artificial Intelligence can help minimize. By limiting the consumption of power using an AI algorithm. Therefore, by narrowing participants' abilities in solving Blockchain algorithm quickly will help limit the amount of computational power used and conserve any additional power and work from other participants. A caveat with AI is that it "demands special computers to run those algorithms with high end resources" (Wahaibi and Jose, 2020, p. 3), which are uncommon—for now. However, the decentralization of

Blockchain offers a way to create an AI platform in a decentralized- distribute platform which allows developers to globally share unutilized power for AI algorithm purposes—gaining access to other available resources and trying to be more sustainable.

Gaining some control over limiting the amount of computational power should be an encouraging sign of potentially implementing Blockchain (with AI) in literary studies. Though it is a work around, it shows improvement and reassurance that although Blockchain or AI can work well separately, the combination of innovative technologies shows promise. In academic forgeries, Wahaibi and Jose (2020) explain how Artificial Intelligence can use its machine intelligence to detect any forgery or fraud. With the help of Blockchain, it enables the ability to justify AI's decisions because Blockchain records and timestamps every transaction and/or interaction. Thus, recording a process that is difficult to justify on actions alone.

Whereas Blockchain utilizes cryptographic algorithms to secure personal data such as personalized information for recommendations and /or medical notes medical notes. This information is then stored and encrypted on a blockchain, but unlike AI, Blockchain needs the support from AI algorithms to assist with encryptions without revealing important information. Blockchain "is able to store large amounts of encrypted data and AI is able to manage it effectively" (Anna Oleksiuk, 2022, para. 14), adding another layer of protection and effective use of AI and Blockchain. So, in terms of security, researchers may not be focused on the security of their work, especially when researchers are incentivized to be gate kept their work, so access can be sold. However, security is like a bonus to a distributed database that encourages access, organization, and verification.

AI Applications, platforms, and tools

Some examples of AI applications are the facial recognition function on Apple iPhones to verify identity and purchases and unlocking phones for usage; Google's search bar ability to correctly recommend search suggestions; or more generally, speech recognition, customer service, computer vision, recommendation engines, and automated stock trading.

There have been some incredibly interesting developments in the creation of literature utilizing AI like Pablos Gervás robot poet, WASP (Wishful Automatic Spanish Poet). Gervás spent 17 years perfecting his robot poet and said that "the purpose of his research is to understand the structure of poetry and study the creative process, to make writers' work easier. They are not trying to replace poets, as their writing lacks emotion" (BBVN, para. 5). Another example is Benjamin, a long short-term memory (LSTM) the first screenwriting software. Benjamin was created by scientist, Ross Goodwin and his team. Benjamin's first work is called "Sunspring", directed by filmmaker Oscar Sharp. Benjamin's work was presented at Sci-Fi London and selected in the 10 best short films (Briegas 2018). And, in Japan, the Nikkei Hoshi Shinichi Literary Award allows non-human authors to anonymously present their work to the competition's judges. Judges have stated how the computers' work are incredibly well-structured although the structure is severely lacking in the psychology of characters (Briegas 2018).

It is incredible what kind of technological inventions are being created to assist creative writers in their creative writing process. Where digital tools such as scite.ai and Semantic Scholar help researchers collect and understand their sources more effectively and efficiently. Some applications that utilize both Blockchain technology and Artificial Intelligence are Versiart, Blackbird. Ai, and Hannah Systems. Versiart is a company uses AI and Blockchain to certify and verify works of art in real-time. They allow artists to create tamper-proof certificates, ensuring credit and immutability. Versiart utilizes the combination of Blockchain and AI to not only archive artwork but establish artists' credit for their work. Blackbird.ai and helps organizations detect and respond to misinformation and manipulation of information that could cause reputational and financial harm. Blackbird.ai uses AI and Blockchain to determine and rate the credibility of news content. Hannah Systems utilizes AI, deep learning, and Blockchain to exchange data of real-time, traffic information. Hannah Systems deep learning predicts road information based on criteria such as jaywalking and speeding, weather, traffic congestion, etc. The incorporation of Artificial Intelligence with blockchain is fairly new, but the implementation of blockchains in literary research is fresh, let alone blockchains with AI.

A Blockchain + AI Database

An ideal option would be to create my own database that utilizes components from AI and blockchains. Similar to other databases such as scite.ai or Semantic Scholar, and other databases before using the blend of technologies to entice a new generation of databases of traditional applications incorporating AI and blockchain technologies for literary studies. The characteristics of a decentralized database are:

- Allow anybody to store and access information across boundaries
- Allow anybody to participate in persisting the data
- Persist to updated data and record the changes made to the data in a traceable manner
- Allow all users to control and manage their data by facilitating the persistence of encrypted data

(Krishnan and Kumble, 2020, chpt. 6).

This is a mock-up of a distributed database (blockchain) of online resources that would function to manage the data recorded on the blockchain: if there were any changes made by the creator or publisher, new editions produced, transfer, renewal or removal of ownership, the distribution and acquirement of both physical and digital assets, and/or the scarcity of copies made for resource distribution, etc. This would be an open access database built on a blockchain with AI components incorporated into its programming. To ensure the blockchain in accessible to anyone on the network, this is a public, smart contract-based blockchain that anyone can join. By utilizing a smart contract-based blockchain, it is ensuring transactions do not solely rely on trust alone for participants anxious or new to the platform. On this blockchain, this digital ledger would hold both physical and digital work for literary research, by utilizing NFTs to record and to digitally hold on to physical items for long preservation such as books, manuscripts, recordings, maps, artifacts, etc.

CHAPTER FIVE: BLOCKCHAIN, RESEARCH, AND LITERARY STUDIES

In my literature review, I asked: why the humanities were reluctant to use digital tools for success, what we can do to keep up with a growing digital environment, and why researchers don't like to share their research. Humanists are interested in concerns of value and interpretation, as well as the domains of rhetoric and logic, subjective judgement and verifiable truths. Humanists have been challenged to be pellucid for digital capabilities to be practical and operable in computational environments (Burdick 2016). There have been previous phases where resources were made, established, and understood with the belief these resources will be adopted into departments and programs, utilizing what they were given. Clare Warwick stated: "The plan, then, was to provide good resources for users, tell them what to do and wait for them to adopt digital humanities methods. Frustratingly, potential users seemed to stubbornly resist such logic. The uptake of digital resources in the humanities remained somewhat slower" (2012, p. 1). However, this was an ineffective assumption, entrusting that people would utilize those tools after being researched and produced, then taught. Knowing that the tools are there is simply not enough. The humanities base their trust and understanding about technology on the experts who can create, manipulate, and maintain digital resources. But humanists can successfully sustain within a developing, digital environment using and incorporating digital tools like blockchain.

Blockchain values transparency, security, efficiency, traceability and auditability, and cost reduction. I am not suggesting an immediate adoption, or completely changing current research methods to new ones, but trying to encourage humanists to gradually try and adopt new methods to their current practice of research.

As the digital environment continues to rapidly develop and influence how we research, it is important to consider or at least be aware of the progression of digital tools like Blockchain and Artificial Intelligence. Considering the demand on the production of research and how research is translated through digital technology. Most institutions have access to digital tools and are more forward thinking with technology, whether their priorities are dependent on technology or not. But how we pursue and conduct research is changing in a digital landscape. So, how can Blockchain help researchers have access? Could it also benefit my own research in Literature? Well, it depends. Some of the advantages of Blockchain are how it is decentralized, immutable, and secure. Although, it can be expensive and is not beginner friendly—yet. I would say there is potential of implementing blockchain technology in literary studies when it comes to research and access.

Blockchain is a decentralized, distributed database that encourages organization, transparency, efficiency, and security. It is an innovative yet disruptive technology that was essentially programmed to give the control back to the people. By administering blockchain technology in literary studies researchers can monitor the secure distribution of their research and keep track of the number of copies distributed. It can also help manage any updates and records any changes made to the data, whether it is an updated author's note or change, transfer, or removal of ownership. By utilizing a blockchain with the assistance of AI, institutions can eliminate the need for high-cost intermediators to manage their research for them. Some programs and organizations like Versiart, Blackbird.ai, and Hannah Systems offer services to help artists, businesses, etc. in using blockchain and AI technology to help verify information for accuracy and manage their assets. Versiart helps preserve and accredit artists for their work (copyright and archives), while Blackbird.ai verifies for accuracy and the potential of fraud (security, verification, peer review). Hannah Systems provides up-to-date traffic information using a set of criteria, which honors the transparency and security of their systems data. These organizations offer services that may not *truly* follow a decentralized network because Versiart, Blackbird.ai, and Hannah Systems would be more so a traditional exchange with an intermediator. For examples, the artist would entrust Versiart to assist and handle their assets on a blockchain. The artist is not renouncing their control but transferring some of their control to Versiart. I believe because people are still unfamiliar with blockchain, it may not be something worth investing their time or money in. Its ambiguity may be the cause of its own learning curve, but I hope blockchain technology will persist in becoming more user-friendly.

The control of one's assets should be one's alone. So, in terms of intermediators and copyright, in a decentralized distributed network eliminates the need for third parties. Therefore, for copyright infringement cases the use of blockchain technology and AI could gradually eliminate or control the limitations of academic publishing and library acquisition application (e.g., data management, etc.). Some examples of the limitations could be incentivizing publishing with a journal and basically hiding research behind a paywall. This not only guards research away from those who are not affiliated, but also those unable to afford multiple subscriptions. Whereas a blockchain can store and distribute research under the supervision of the creator, or researcher. Blockchain can also be used to verify a researcher's credentials, if available; and AI can be trained to verify and fact-check research. Thus, enabling the possibility of speeding up the peer-review process or eliminating and entrusting a peer-review AI. Another limitation of academic publishing and library acquisition application related to copyright is ownership. If the rights to a particular work were to expire, transfer, or be renewed a blockchain can keep track of the most current owner. A common issue with copyright infringement is understanding and locating who the current owner is, whether is it a publishing house, research center, next of kin, etc. And blockchain and AI can assist in locating the most current owner by storing related data on a blockchain and verify the assets, personal information, and transfer with AI. And blockchain is anonymous, which is to keep participants' identities private and secure. So, even though AI may check to verify your credentials, it is to not expose any of your personal information. Blockchain is a database that does not collect personal data like other applications that often request users to input their data. It is the choice of the participant of what information is accessible. It is also secure because records, once placed on a blockchain are immutable. And by training suitable AI models to produce better results, by accessing and using decentralized databases' data could increase trust or the immutability of data through more intensive AI training.

It is also a secure form of access because it can monitor who has and requests access and offers a more open research environment. It allows access to everyone without hiding behind a toll wall. Research is supposed to be shared, and blockchain can create an effective and efficient open-access, secure network that manages the distribution and access to research. Therefore, encouraging transparency in the research process and the availability of research to those with or without institutional access. Blockchain values transparency and transparency encourages researchers to be honest about how they conduct their research, which can be a vulnerable situation sharing your research process but liberating. Honest researchers are committed to the scholarly values of exchange. Thus, transparency is key to be honest with our audience.

I wanted to give researchers the tools to take control of their own research processes. Because research should not be influenced by professional development, pressure from our institutions, competition, or funding. Those can be motivators, but the ultimate goal is to conduct research to share. Implementing blockchain technology in literary studies enables researchers to securely manage and keep records of the distribution and access of their own research, and monitor the output of other scholarship. Ultimately, blockchain and AI work succinctly together to support each other's strengths and limitations, which encourage the implementation of Blockchain with AI in literary studies.

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