ISEC-700 Fall 2022

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Assignment #2 Guidelines for Research Pre-Idea Paper in Cybersecurity

November 27th, 2022

## **Problem Statement**

The research problem that the study will address is how to defend against centralization in blockchain technology with a focus in Asynchronous Byzantine Fault Tolerance (aBFT) protocols. To properly address how to defend against centralization in blockchain, a few key theories need to be discussed that fuel the decentralization discussions. Beginning with a fault tolerance problem proposed by the works of **(Lamport et al.1982)** called the Byzantine General Problem (BGP). The BGP is argued to be the underlying philosophy behind blockchain theory and is supported by the proposed statement from (**P. Kuo, 2019)** that “The Byzantine general problem is the core problem that consensus algorithms are trying to solve, which is at the heart of the design of blockchains.” The research articles on the BGP mentioned above are important to defending against centralization in blockchain technology because the contents question underlying issues related to decentralized distributed systems through the BGP.

The next theory that needs to be addressed is the Blockchain Trilemma. A reference to the Blockchain Trilemma is proposed in the works of **(Aiyar, Halgamuge and Mohammad,2021)**  and states that “three important properties of a blockchain system, involving decentralization, security, and scalability, cannot perfectly co-exist.” The establishment of the Blockchain Trilemma asserted in the research above is important to defending against centralization, because the research quoted claims that there is no one size fits all answer to blockchain solutions and that gaining a better position on one side of the Blockchain Trilemma means losing positions on the other side. **(Aiyar, Halgamuge and Mohammad,2021)**

The next theory to be discussed is the Fischer Linch Patterson (FLP) Theorem that states “an asynchronous network where messages may be delayed but not lost, there is no consensus algorithm that is guaranteed to terminate in every execution for all starting conditions, if at least one node may experience failure.” **(Fischer, Lynch, and Paterson, 1985)** The FLP theorem is is an important theorem in decentralization and can be seen referenced in other research articles such as such as in the works **(Kaushal, Bagga, and R. Sobti. 2017)** that states **“**The consensus in a decentralized environment raises serious issues. In literature, there are some impossibility results in distributed consensus like Byzantine’s Generals’ Problem, and Fischer Lynch Paterson impossibility of distributed consensus with one faulty process.” The FLP theorem is specifically important to decentralization of asynchronous blockchain protocols because FLP was the base problem for The Honey Badger (HoneyBadgerBFT) protocol innovating its atomic broadcasting.**(Andrew Miller, Yu Xia, Kyle Croman, Elaine Shi, and Dawn Song. 2016. )** The HoneyBadgerBFT protocol is accepted in academic research as major breakthrough in practical asynchronous BFT algorithms **(ABFT,2021)** The FLP theorem from 1985 influencing the conception of the HoneyBadgerBFT in 2016 is important to defending against centralization in blockchain because it shows that aBFT is just now starting to be developed and researched in regards to blockchain technology.(**BEAT)**

The problem of centralization is blockchain is that it can create vulnerabilities in the distributed system whit the impact potentially being Denial of Service (DoS) attacks and falsified records.**(Q. Lin, C. Li, X. Zhao and X. Chen, 2021)** Because of the potential impact to security mentioned above it is important to defend against centralization in decentralized distributed systems. The Current gap in knowledge being that blockchain systesm have high costs and low throughput or they gain advantages in those categories by giving up decentralization.**( Y. Jia, C. Xu, Z. Wu, Z. Feng, Y. Chen and S. Yang, )** This is particularly true with aBFT protocols such as the HoneyBadgerBFT that are considered to have a high run time overhead and low scalability **(H. Knudsen, J. Li, J. S. Notland, P. H. Haro and T. B. Ræder)**

## **Research Goals**

- The main goal of this research study is to…

- Better understand the future of aBFT

- The need for this work is demonstrated by the work of ...(explain precisely but short each research and based on what conclusions were made)

- HoneyBadgerBFT, BEAT, ALGO, ABFT

- This dissertation builds on previous research by…

- HoneyBadgerBFT, BEAT, ALGO, ABFT

- The X\* specific goals of this research study are…

-Understand how asynchronicity can help defend against centralization.

- The main research question that this study will address is…

- how does asynchronicity defend again centralization.

- The X\* hypotheses that this study will address are... (Each hypothesis should directly be tied to a specific research goal and be a “measurable outcome” – see dissertation guide on what constitute goals!)

-aBFT will become more prevalent in blockchain in the future.

-aBFT will provide advancements in blockchain.

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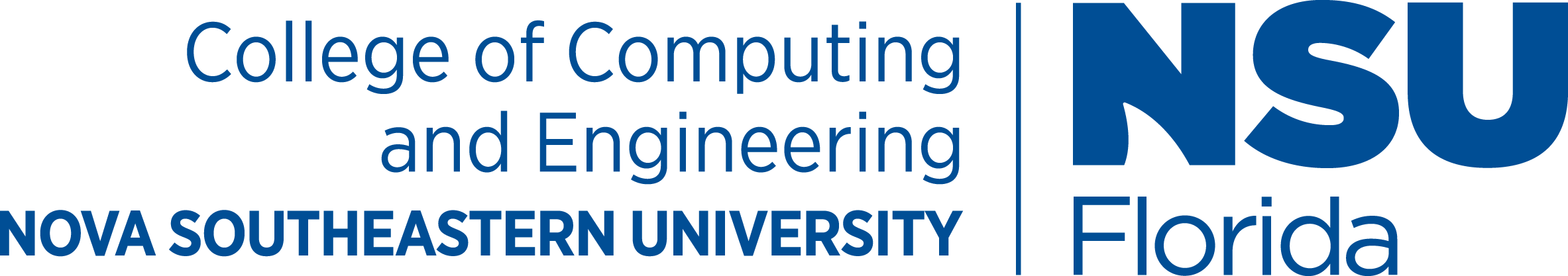
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**Certification of Authorship of Doctoral Course Assignment**



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Date of Submission: November 6th, 2022

Purpose and Title of Submission: Assignment #1 Research Problem and Theory Review in Cybersecurity Management Paper

Certification of Authorship: I hereby certify that I am the author of this document and that any assistance I received in its preparation is fully acknowledged and disclosed in the document. I have also cited all sources from which I obtained data, ideas, or words that are copied directly or paraphrased in the document. Sources are properly credited according to accepted standards for professional publications. I also certify that this paper was prepared by me for this purpose.

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