

# 95-410/810 Blockchain Fundamentals

Heinz College, Carnegie Mellon University

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**TA:** TBD

**Term:** Fall 2024, Mini 1

This class meets **IN PERSON** - Mondays 6:30pm - 9:20pm in **HBH 2003**

August 26, 2024 through October 11, 2024

## Course Description

This course will be on the fundamentals of Blockchain and Blockchain Technology. After covering fundamentals we will look at some applied uses and also criticisms. The best known example of Blockchain Technology in wide use today is as the storage and transaction mechanism for the cryptocurrency Bitcoin. There are many other cryptocurrency networks that also use similar technology including Ethereum and Algorand. We will also use historical examples, key concepts, theory vs. practice, and examples of proposed and implemented solutions to help explain Blockchain Fundamentals. A focus for the class will be on the challenges of a given problem area and the decisions made during implementation. The history of the design and research process that ultimately led to a 'successful' implementation for a cryptocurrency is decades long. Bitcoin represents an elegant technical solution to a series of long posed problems which we can use to learn from. Its history as a solution builds upon many years of previous academic research some of which we will also explore during class. For even more specifics, see Narayanan, Arvind, and Jeremy Clark. "Bitcoin's academic pedigree." *Communications of the ACM* 60.12 (2017): 36-45.

Whether these technical solutions (or similar ones) can be applied to other industry problems beyond cryptocurrency remains an interesting and ongoing research and implementation problem. After covering Blockchain technology fundamentals, we will explore applications of Blockchain and Distributed Ledger Technology and focusing on current and potential uses beyond that cryptocurrency.

## Textbooks

We will use a variety of books, articles, journal papers, sources, videos, demos, and interactive materials in the course. You are not required to purchase any text to have access to all of the course reading assignments or optional materials.

There is a textbook on cryptocurrency which we will read from titled *Bitcoin and Cryptocurrency Technologies*. You can download a free pre-publication version of the book at <http://bitcoinbook.cs.princeton.edu/>. You are not required to own a hard copy. The book website also contains a large number of interesting Blockchain related links which you are encouraged to explore.

Other reading materials will come from Journals, Magazines, or Newspaper articles that CMU has online access to. We may occasionally use chapter excerpts from other books that will be made available to you on Canvas. All materials made available are only for use in this class.

## Learning Objectives

Upon successful completion of the course, each student will show tangible evidence of growth and maturity in the following areas:

1. Be able to state core blockchain concepts, the benefits, and the limitations of blockchain technologies.
2. Be able to state the key differentiators for blockchain from other technology systems.
3. Understand the technical underpinnings of blockchain technology at sufficient depth to perform analysis of the impacts of certain implementation decisions in proposals.
4. Understand relevant legal, ethical, and privacy issues around blockchains and how they might impact policy and actions of organizations or individuals.
5. Apply various blockchain concepts to analyze examples, proposals, case studies, and preliminary blockchain system design discussions.
6. Make decisions about the use (or not) of blockchain technology in systems, and support decisions with relevant arguments.
7. Perform and defend blockchain analysis of real world systems and present relevant findings and arguments in a structured, logical and compelling manner.
8. Determine real world challenges that blockchain technologies may assist in solving; or explain why they do not.

## Assessments and Final Project

This course will consist of the following major assessments:

### **Homework Assignment 1 - Explanation of key concepts in your own words**

You will be asked to write a short essay to explain the major concepts of blockchains. You may supplement your writing with drawings or pictures and contrast blockchains with other kinds of technology. You will also be asked to think of your own anecdotes to help explain blockchain concepts, key challenges, and solutions to someone who is unfamiliar with the underlying technical elements. Assignment details will be posted on canvas.

### **Homework Assignment 2 - Challenge Problem Sources, Outline**

In your final project, you will be asked to choose a challenge problem and analyze how a blockchain might be used to solve it. Your assignment in homework 2 will be to choose a challenge problem and clearly articulate why it is a challenge, explain the particulars of the problem, attempt to explain the current state solutions and why they may or may not be an improvement over a blockchain. You will also identify a minimum of 4 sources that you will use in your final project. You will write an outline for each of the sections in your final project.

### **Final Project**

After you have chosen your challenge problem, you should articulate the details of that challenge further, and explain the challenge that you think a blockchain system might help to solve. In short, you will explore the challenge and articulate the parts of the challenge that make it hard.

Explain why a blockchain might be a possible solution for this problem - and what benefits are derived in the case that blockchain technology would be used over other alternatives (to include a private database, or an intermediary company that stores data and helps perform 'transactions' for others). You should pose a list of questions to yourself on why blockchain might be a good fit for the problem you have chosen. You should also explain what changes, design decisions, or tweaks you would need to make to your proposed blockchain solution so that it would appropriately fit your problem.

Each major assessment and its due date will be posted in more detail to Canvas.

In addition to these assessments, you will be asked to answer questions on the reading and lectures throughout the course. These short assignment questions will also be posted to canvas. These minor assignments will typically ask for a written paragraph or two, or will ask a series of questions each of which will ask for short answers (eg. 1-2 sentences).

All assessments will be conducted through Canvas. Class discussion will be in person and via or the class Discussion board which is hosted on Canvas.

## **Academic Integrity**

Carnegie Mellon is a self-governing institution that requires ethical behavior of its administration, faculty, staff and students that goes beyond simple compliance with the law. Respect for these requirements creates a moral authority for the university to insist upon appropriate behavior. This authority is essential to the accomplishment of the university's mission. Integrity as described in this statement is a defining feature of the university community's high expectations for the conduct of its members.

Academic Integrity is a core CMU value, and as a member of the CMU community, it is important that the work you turn in for this class is wholly your own. As your instructor, I will strive to ensure that you develop the necessary knowledge and skills to meet the learning objectives for this class, just as it is your task to put in the effort to complete the work and ask

for help if you need it. In this hybrid/remote environment, you might have questions about what is and is not acceptable. I will attempt to provide resources clarifying what cheating, plagiarism, and unauthorized assistance look like and how to avoid them. You should always refer to the CMU resources on academic integrity if you have any questions or concerns -

<https://www.cmu.edu/student-affairs/theword/academic/statement-on-academic-integrity.html#statement>

**In particular, for this class, if you use language in written submitted work you MUST encapsulate it in quotes AND cite the source of the work. These are not your words and you must cite all references. We will be using software in the class to identify sequences of words and statements that have been submitted elsewhere. You will need to ensure that you follow correct CITATION guidance which will be provided on the first day of this course. This applies to all assignments, all projects, and all submitted graded work.**

**This class is intended to make you think and to write down your thoughts. Your work will often rely upon the thoughts and words of others. You MUST cite and acknowledge these works while also avoiding heavily quoting from material for the bulk of your written assignments. We are looking for your own work, not a rehash of the work done by others. As you discuss and build or apply a point made by another author, you may need to state their point in their words. You MUST QUOTE THEM AND CITE THEM. If you do not, your submission can be considered plagiarism as you are indicating by not citing them that the words and the sequence they are put in are your own.**

The consequences of plagiarism can be an academic referral. Please avoid plagiarism or any type of cheating in this class. You may of course ask questions and ask for help from the instructor if this is unclear. Each student is responsible for handing in their own work. For any assignment found to be the partial result of cheating or plagiarism, your grade for that assignment will be a Zero and may result in academic referral, and/or a failing grade in the course.

Cheating includes inappropriate collaboration among students on an assignment. Plagiarism also includes copying sequences of words from external sources with or without alteration and failing to encapsulate them in quotes and/or cite their source. **You must also properly cite sources of ideas, sentences, and to place any sequences of words from others in any quotes that you choose use in your work.** You should also not overly rely upon quotes from others for assignments where you original work is assigned including all Homework and all Projects. Canvas contains very specific examples and guidance on how to avoid plagiarism. **You Must review the canvas page on plagiarism, citing external sources, and more prior to HW1.**

Any violations may result in penalties including a zero for the assignment, or failing grade in the course. If students are found to be collaborating without prior approval, BOTH will pay the penalty regardless of who originated the work.

## Generative AI

It is not outright banned, but I encourage you to know that it must be used correctly in order to help you accomplish learning or to perform highly in class assignments.

Universities around the country are evaluating the benefits and drawbacks of students' use of generative AI technologies in the classroom. Regardless of what universities eventually do, Generative AI will be a tool in the post-academic world that many of you will be inhabiting in your professional careers. I will offer some key thoughts and references on Generative AI here and suggest that at this time it is in your great benefit to avoid the use of Generative AI in this (and other classes) in nearly all circumstances.

### **Our official policy on the use of Generative AI in this course is:**

All reading assignments, homework assignments, and final project require your own original work. This means that if the minimum word count on an assignment is 1000, the way to interpret that is for you to write “1000 original words from your own head”. There are research backed learning outcome improvements when you write your own words such as **“Frequent writing in courses has been shown to improve content retention, critical analysis, literacy, and, not surprisingly, writing outcomes.”**<sup>1</sup> Writing improves learning. **If you ask a machine to write for you, I promise that it will not write as well or as originally as you could have yourself.** This applies to BOTH native English speakers and non-native English speakers. The author Ted Chiang says this about AI writing:<sup>2</sup>

*“Obviously, no one can speak for all writers, but let me make the argument that starting with a blurry copy of unoriginal work isn’t a good way to create original work. If you’re a writer, you will write a lot of unoriginal work before you write something original. And the time and effort expended on that unoriginal work isn’t wasted; on the contrary, I would suggest that it is precisely what enables you to eventually create something original. **The hours spent choosing the right word and rearranging sentences to better follow one another are what teach you how meaning is conveyed by prose.**”*

***Having students write essays isn’t merely a way to test their grasp of the material; it gives them experience in articulating their thoughts. If students never have to write essays that we have all read before, they will never gain the skills needed to write something that we have never read.”***

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<sup>1</sup> Source: <https://www.jjay.cuny.edu/how-use-writing-your-classes-improve-student-learning> Accessed August 15, 2023

<sup>2</sup> Source: <https://www.newyorker.com/tech/annals-of-technology/chatgpt-is-a-blurry-jpeg-of-the-web> Accessed August 15, 2023

The article contains many other good points on how LLMs are not going to improve your understanding over other sources, and **they will not generate better written words about even simple topics than you do.**

If you choose to use Generative AI to generate words, you **MUST** cite all words that are produced by the tool as being not written by you. You must put the output of the AI in quotes and you must cite their source as being AI generated. If the text is inaccurate, vague, poorly worded, includes hallucinations, or are generic (and so do not add any new ideas to the reader) your grade will be reflective of these errors.

Executives in industry will be treating any professional writing that you do in a similar manner. I promise you that any executive who asks you what the fundamental ideas in Blockchain technology are and your opinion on why those might be important can surely type that same question into a generative AI model, and can probably even do some minimal prompt engineering to get a result similar to what you would get with your input. What they would not get, and what they want is **YOUR** opinion, thoughts, unique ideas, and perspective on the question. They will use your input to make key future business decisions about what to do with the technology that runs their business. **Savvy Business Executives will not be asking AI nor trusting its opinion on the same question that they ask you.**

In summary:

- If you want to learn and to achieve a high performing grade in this class, complete writing assignments yourself. The learning during the writing process is why we do writing assignments instead of exams. Essays are much more time consuming to grade for instructors than exams, but students learn more through the process of writing things down. They also learn more about both themselves and the material when they write (including revising, re-writing, polishing/editing, revising again, and proof-reading). These are communication skills you will be expected to perform in your professional capability regardless of what field you are in.
- **You must follow the academic integrity guidelines of the university and of this class.** If you use one of these generative AI tools to develop content for an assignment, you are required to cite the tool's contribution to your work. In practice, cutting and pasting content from any source without citation is plagiarism. Likewise, paraphrasing content from a generative AI without citation is plagiarism. Similarly, using any generative AI tool without appropriate acknowledgement will be treated as plagiarism. The [university's policy on plagiarism](#) applies to all uncited or improperly cited use of work, whether that work is created by human beings alone or in collaboration with a generative AI.

Lastly, you may not use generative AI programs to:

- Generate content that you cut and paste into an assignment with a written component without quotations and a citation
- Generate content that is not adequately paraphrased without a citation
- Generate bibliographies for topics that you haven't researched yourself

- Generate other content (images, video, others) unless expressly permitted and following provided guidance
- Otherwise use or present generative AI content that you pass off as your own work, when it is not

AI generated content does not count toward assignment minimums such as word counts for original words.

Finally, it is important that you recognize that large language models frequently provide users with incorrect information, create professional-looking citations that are not real, generate contradictory statements, incorporate copyrighted material without appropriate attribution, and can sometimes integrate biased concepts. Code generation models may produce inaccurate outputs. Image generation models may create misleading or offensive content.

While you may technical use these tools in the work you create for this class (as will be the case in real life as well), it is important to note that you understand **you are ultimately responsible for the content that you submit**. Work that is inaccurate, biased, unethical, offensive, plagiarized, or incorrect will be penalized.

## Grade Evaluation Method

15% - Course Reading, Comprehension, Assignment Question & Answer

15% - Homework Assignment 1

15% - Homework Assignment 2

40% - Final Project

10% - Class Discussion & Participation

05% - Professionalism

## Grading Scale

100 - 98 A+

97-92 A

91-90 A-

89-88 B+

87-82 B

81-80 B-

79-78 C+

77-72 C

71-70 C-

## Grade Distribution

Heinz School guidelines will be used in deciding on the overall grade distribution. However, I grade individual assignments on an absolute scale. If every student does well in the class, each will get an A+ regardless of the recommended grading scale. The same holds true on the other end of the scale.

## Late Submissions. Make Up Work?

**Normally, I do not accept late work without prior arrangement.** Due dates for every assignment are provided on the course syllabus and course schedule (and posted in Canvas). Unless otherwise stated, assignments are due on those days. However, I recognize that sometimes “life happens.” Remember that your other fellow students will have already submitted the work on time. At the instructors discretion (and a penalty may be applicable), they may attempt to work with your based upon your circumstances.

### *Late Final Projects*

Late Final Projects submitted up to 24 hours after the due date and time will only be eligible for 80% of the maximum number of points allotted. Since Final Projects are the largest portion of your final grade, submitting them even a few hours late can drop your final score by nearly a full letter grade. I highly encourage you to submit Final Projects before the final due date. Assignments submitted more than 24 hours after the due date will not be accepted.

## Attendance, Attending Late, Absence

Class participation and discussion comprises approximately 10% of your final grade. Your attendance in each class counts as a partial score. The rest of the partial score will be determined by your participation in class. The class is designed to have students attempt to reason about answers to questions and you are highly encouraged to ask questions. If you have a question, someone else probably does to, and you will are being graded on participation as well.

Attendance is not typically tracked on Canvas until the end of term. You may see your % total score jump down if you are not attending class regularly, are late, or are not present during attendance. It is YOUR responsibility to contact the instructor about being late or absent or not present during attendance. If you do it days or weeks after it happened, there will not be any opportunity to change scores.

Attending Late – We do take attendance in class. If you come late, it also means that you were not participating in discussions, asking or answering questions with your other peers. A few minutes one time is one thing, but anything more and you must email the instructor before the class, or the day after, and may need to perform a makeup assignment depending upon how late you were that day. Multiple lates in a row begins to approach issues with professionalism which is also part of your grade. If you have a very extenuating circumstance that requires you to always be late or leave early, you must discuss this with the instructor at the beginning of the semester. **Being late applies to both remote classes and in person classes.**

Missing Class – Life does happen and there are emergencies. If you have an emergency such as a medical event and need to miss class, you need to contract the instructor in advance, or when you are soon able to following your situation. It is my policy to record class, so if you do this we can usually arrange for a makeup assignment. If you know that you will have a more



disruptive situation for attending class on time, please email the instructor right away. Since the class is a mini and we only meet once a week, missing class can be a significant amount of material.

**Canvas Discussion board.** For both in person and remote offerings, we will also have a discussion board thread for each week of class on canvas. You can make a post which is typically 1-2 paragraphs with a reflection, question, or other kind of engagement with the class material that week. The best posts are those that show you thought about how the concepts we discuss in class apply to events or ideas you have in your own life, or those of others you know.

**Participation for Remote classes.** This class is sometimes taught as a remote offering. Participation in remote classes is generally the same, although sometimes over Zoom it can be harder. Asking questions in the chat is usually ok, but the preferred method is to raise your hand and turn on your camera. From my many experiences delivering this class on Zoom; **students with their cameras on typically have higher participation in the class.**

If you are confused, your confusion may also be shared by other students so please ask the instructor a question. Many of the topics we are covering in class can have multiple viewpoints. This can cause confusion even among professionals in the field. Many professionals can have a difference of opinion on a given issue. This class is an attempt to help you participate in such conversations using the framework, language, and skills of practicing analysis of blockchain technologies. Asking questions and attempting to answer the questions of others is an important learning step and counts toward class participation.

Please do your best to attend, and if given advanced notice of an absence or late, the instructor may provide opportunities for reasonable asynchronous work. This will generally include watching the small parts of lecture that you miss, reviewing the handouts and slides, and performing an assignment of make up work such as posting to the discussion board. If you become ill for a few days or encounter an emergency situation, contact me in advance or as soon as possible and we will make arrangements for you to make up the material that we covered in class using a short assignment. If you contact the instructor after a late or absence with an emergency situation there will not be any makeup assignment. Makeup assignments are used very sparingly (such as one time) without an official accommodation.

Again, if you are ill, please contact the instructor prior to the beginning of class and we will make arrangements for you to make up the material that we covered in class. Do not come to class if you are ill.

## In-Class Participation & the Canvas Discussion Board

This class is designed to encourage in-class discussion, post reading reflection (writing), and pre-class prep (writing). We will leverage both discussion in person and we will also leverage the discussion board as part of grading to show class participation in addition to remote

sessions. This does not mean that a single comment on the discussion board will lead to a justification for a better grade. **This class asks for (and grades for participation are based on) sustained engagement and participation through class and/or through the discussion board.**

Discussion board - The discussion board will serve as both a mechanism for prep work for class (e.g., you may be asked to post questions that you have about the assigned reading or for an upcoming guest speaker) or as post-class work e.g., you are encouraged to post a list of takeaways from today's class session, thoughts on their applicability to your own life or industry, and more.

You will also be asked to answer questions about the readings during class, but since we have limited in-person time together, the discussion board is another option for showing your participation through repeated and sustained posts.

Here are other ways you can show class participation and reading comprehension on the discussion boards:

1. After you have completed any pre-class reading, post areas that did not make sense to you. Reading assignments will usually be reflective of basic topics, relevant research, current events, or new results on blockchain concepts that are directly related to the material being covered in class. You can post personal reflections about these.
2. Participate in class discussions including attempting to answer questions from the instructor and from other students, performing active listening, and asking pertinent questions of your own. In class, pay attention and after class post a written reflection, attempting to clarify information that you do or do not understand (in class or after class on the discussion board), and attempting to summarize the information you have heard or read about.
3. Write a post trying to relate the concepts you are learning about in class that week to specific examples in your own life and sharing your own thoughts and experiences on these with the class.

## Diversity

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and

staff bring to our campus. We, at CMU, will work to promote diversity, equity and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment.

Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional.

They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment on the basis of identity to speak out for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

- **Center for Student Diversity and Inclusion:** [csdi@andrew.cmu.edu](mailto:csdi@andrew.cmu.edu), (412) 268-2150
- **Report-It online anonymous reporting platform:** [reportit.net](https://reportit.net) username: *tartans* password: *plaid*

All reports will be documented and deliberated to determine if there should be any following actions. Regardless of incident type, the university will use all shared experiences to transform our campus climate to be more equitable and just.

## Accommodations for Students with Disabilities

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at [access@andrew.cmu.edu](mailto:access@andrew.cmu.edu).

## Student Wellness - Take Care of Yourself

We want you to succeed in this class. If you are finding that this is a struggle, know that you are not alone. If you are having issues, please ask for help. All of us benefit from support during times of struggle. You are not alone. There are many resources available to help you in the Heinz College, on the CMU campus, and among your instructors.

If you or anyone you know is experiencing academic stress, difficult life events, or feel anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is available to help. Call 412.268.2922 and visit the website <https://www.cmu.edu/counseling/>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to support that can help.

## Use of Technology in the Classroom

Research has shown that divided attention is detrimental to learning, so I encourage you to close any windows not directly related to what we are doing while you are in class. Please turn off your phone notifications and limit other likely sources of technology disruption, so you can fully engage with the material, each other, and me. This will create a better learning environment for everyone.

*For in person class you will not need to bring your laptop.*

See the professionalism section below for guidance on the use of devices in class. You will be expected to act and behave as in a professional setting. You may use a laptop to take notes during class if that is your preference.

## Professionalism

All students (and especially graduate students) are expected to conduct themselves with respect toward each other. This includes showing up on time, paying attention during class, and not distracting others during class. It can be helpful to image the class as similar to a business meeting where you are expected to follow along, be ready to add new thoughts and idea, and to give your opinion on certain issues to executives at a moment's notice.

Class Participation includes your active participation in discussions. If you are not answering a question, or asking a question, please try to focus your attention on the person that is speaking. Discourse on any topic can sometimes become heated. Students will be expected to act and behave as if they are in a professional setting.

## Class Recordings

For this course, I will be recording class sessions and making them available to you for your personal, educational use. Recordings of class sessions are covered under the Family Educational Rights and Privacy Act (FERPA) and must not be shared with anyone outside class. The purpose of these recordings is so students in this course (and only students in this course) can watch or re-watch past class sessions. Feel free to use the recordings if you would like to review something we discussed in class or if you are temporarily unable to attend class.

Disclaimer: I will do my best to record via Zoom so that students in this course (and only students in this course) can watch or re-watch past class sessions. However, for in-person classes, the professors attention will be focused upon students and discussions

in the classroom. Sometimes recordings may not be complete. I will make the recordings available on Canvas after each class session.

## Help with Papers and Projects from the Student Academic Success Center (SASC)

Communication Support offers free one-on-one communication consulting as well as group workshops to support strong written, oral, and visual communication in texts including thesis-driven essays, data-driven reports, oral presentations, posters and visual design, advanced research, application materials, grant proposals, business and public policy documents, data visualization, and team projects. Appointments are available to undergraduate and graduate students from any discipline at CMU. Visit the Student Academic Success Center (SASC) website at <https://www.cmu.edu/student-success/index.html> to schedule an appointment (in-person or video), attend a workshop, or consult handouts or videos to strengthen communication skills.

## Food Insecurity

If you are worried about affording food or feeling insecure about food, there are resources on campus that can help. Email the CMU Food Pantry Coordinator to schedule an appointment: Pantry Coordinator [cmu-pantry@andrew.cmu.edu](mailto:cmu-pantry@andrew.cmu.edu) or call 412-268-8704 (SLICE office)

## How to Succeed in This Class

1. Get started on the research project as soon as possible. Even just spending some time in week 1 thinking about topics you may be interested in learning more about can make a significant difference.
2. Complete the assigned readings for each week, if not before the class for which they are assigned, then after that class and before the next.
3. Participate in class - see section on Class Participation for more specific tips.
4. Use office hours productively. Get feedback on outlines of your research reports, suggestions for references, tips on homework or lab questions, and clarifications of lecture materials. Make sure you are comfortable applying the concepts and lessons learned from course case studies to new requirements or use cases.
5. Complete as much of the research project for the first draft as is possible. You can provide as much of a draft as you like in HW2 and receive feedback in advance of your final draft.
6. Use the SASC programs such as Communication Support. Many students who have used these in the past have substantially improved their writing and communication skills on projects. These

skill translate directly into real-world job skills as well.

# Appendix

## Draft Schedule and Reading Assignments

*Note: The topics and list of reading and videos is subject to change. ALWAYS Check Canvas for the latest updates including changes to the assigned weekly readings.*

#	Date	Topics	Reading/Videos
1	8-26	<p>Introduction and Learning Objectives</p> <p>Blockchain Overview</p> <p>History and Origin of Blockchain (and Cryptocurrency)</p> <p>Start of Technical Concepts of Blockchain Systems</p> <ul style="list-style-type: none"> <li>- Physical Ledger Technology and Security</li> <li>- Digital Ledger Technology</li> </ul> <p>Digital Security Technology</p> <ul style="list-style-type: none"> <li>- Cryptographic Hash Functions</li> <li>- Digital Signatures</li> </ul> <p>Decentralized networks and technology (serverless)</p>	<p>Narayanan, et al. Chapter 1</p> <p>PKI &amp; Digital Signature: Can you Crack the Code? A fascinating history of ciphers and cryptography by Ella Schwartz illustrated by Lily Williams. Chapter 9 "Prime Time". (PDF on Canvas)</p> <p>But how does bitcoin actually work  <a href="https://www.youtube.com/watch?v=bBC-nXj3Ng4">https://www.youtube.com/watch?v=bBC-nXj3Ng4</a> (27 minutes)</p> <p>How secure is 256 bit security?  <a href="https://youtu.be/S9JGmA5_unY">https://youtu.be/S9JGmA5_unY</a> (Video, YouTube 5 minutes)</p>
			<p><b>(Optional) Supplemental Material</b></p> <p><a href="#">How Bitcoin Works in 5 Minutes</a> (Video, YouTube, 5 minutes)  <a href="https://www.youtube.com/watch?v=I9jOJk30eQs">https://www.youtube.com/watch?v=I9jOJk30eQs</a></p> <p>The Eureka Moment that made bitcoin possible - Amy Whitaker for WSJ (PDF)</p> <p><i>Security engineering</i> by Ross Anderson - Chapter 6 Cryptography            SEv3-ch5-7sep Security Engineering Cryptography.pdf</p> <ul style="list-style-type: none"> <li>● 5.2 Historical Background</li> <li>● 5.3 Security Models</li> </ul>

			<ul style="list-style-type: none"> <li>• 5.4 Symmetric crypto algorithms</li> </ul> <p>5.6 Hash Functions</p> <p>Create your own MD5 <a href="https://natmchugh.blogspot.com/2015/02/create-your-own-md5-collisions.htm">Hash Collisions</a>  <a href="https://natmchugh.blogspot.com/2015/02/create-your-own-md5-collisions.htm">https://natmchugh.blogspot.com/2015/02/create-your-own-md5-collisions.htm</a></p> <p><a href="https://www.economist.com/briefing/2015/10/31/the-great-chain-of-being-sure-about-things">The great chain of being sure about things</a> (Article, Economist)  <a href="https://www.economist.com/briefing/2015/10/31/the-great-chain-of-being-sure-about-things">https://www.economist.com/briefing/2015/10/31/the-great-chain-of-being-sure-about-things</a></p> <p>The Money Myth by James Bridle (Article)  <a href="https://www.newstatesman.com/politics/2019/07/bitcoin-and-the-money-myth">https://www.newstatesman.com/politics/2019/07/bitcoin-and-the-money-myth</a></p>
2	9 - 2	LABOR DAY, HOLIDAY, NO CLASS	
3	9 - 9	<p>How traditional Electronic Payment Systems work</p> <p>DLT Technical Concepts Continued:</p> <ul style="list-style-type: none"> <li>- Digital Ledgers</li> <li>- Distributed Networks and Consensus</li> <li>- Incentives, Mining Proof of Work,</li> <li>- Cryptosystems in practice</li> <li>- 51% (and other) attacks</li> <li>- Introduction to Smart Contracts</li> <li>- Altcoins</li> </ul> <p>Electricity Use</p>	<p>Narayanan et al. Chapter 2: How Bitcoin Achieves Decentralization Pages 51 – 72</p> <p>Haber and Stornetta - How to Time Stamp a Digital Document (PDF)</p> <p>Review a few pages of your choice from this website: <a href="https://learnmeabitcoin.com/">How Does Bitcoin Work?!</a>  <a href="https://learnmeabitcoin.com/">https://learnmeabitcoin.com/</a></p> <p>Mining (Video) <a href="https://www.youtube.com/watch?v=K8kua5B5K3I">Inside a Secret Chinese Bitcoin Mine</a> (10 minutes)  <a href="https://www.youtube.com/watch?v=K8kua5B5K3I">https://www.youtube.com/watch?v=K8kua5B5K3I</a></p> <p>Estimating Bitcoin Electricity Use: A Beginner's Guide (By Jonathan Koomey)  <a href="https://www.coincenter.org/estimating-bitcoin-electricity-use-a-beginners-guide/">https://www.coincenter.org/estimating-bitcoin-electricity-use-a-beginners-guide/</a></p>
			<p><b>(Optional) Supplemental Material</b></p> <p>Narayanan et al. Chapter 3: Mechanics of Bitcoin (Page 75 - 98)</p>



			<p>But how does bitcoin actually work? <a href="https://youtu.be/bBC-nXj3Ng4">https://youtu.be/bBC-nXj3Ng4</a> (video 26 min)</p> <p>Back, Adam. "Hashcash-a denial of service counter-measure." (2002). <a href="http://www.hashcash.org/hashcash.pdf">http://www.hashcash.org/hashcash.pdf</a></p> <p><a href="https://www.philzimmermann.com/EN/essays/WhyIWrotePGP.html">Why I Wrote PGP by Phil Zimmerman</a> (Article) <a href="https://www.philzimmermann.com/EN/essays/WhyIWrotePGP.html">https://www.philzimmermann.com/EN/essays/WhyIWrotePGP.html</a></p> <p>Nakamoto "The White Paper"</p> <p>(Article) <a href="https://www.wired.com/story/iceland-bitcoin-mining-gallery/">Inside the Icelandic Facility Where Bitcoin Is Mined</a> <a href="https://www.wired.com/story/iceland-bitcoin-mining-gallery/">https://www.wired.com/story/iceland-bitcoin-mining-gallery/</a></p> <p>"Pieces of code that codify business logic. Store Rules, Verify Rules, <u>Self-Execute</u>." Olga Mack</p>
4	9 - 16	<p>The Ethereum 'Ecosystem'</p> <ul style="list-style-type: none"> <li>- Smart Contracts Continued</li> <li>- Smart Contract Languages (Solidity &amp; Others)</li> <li>- Layer 2 and Payment Channel Networks (Lightning)</li> </ul>	<p><i>Narayanan et al.</i> Chapter 9: Bitcoin as a Platform pages 237 - 247</p> <p>Narayanan et al. Chapter 10 (Altcoins): Ethereum and Smart Contracts 263 – 271</p> <p>(Book Chapter) Blockchain and the Law - The Rule of Code - Chapter 4 Smart Contracts as Legal Contracts (pdf) (17 Pages)</p> <p>(Video) <a href="https://www.youtube.com/watch?v=pA6CGuXEKtQ">How Smart Contracts Will Change the World   Olga Mack   TEDxSanFrancisco</a> (17 minutes. Smart Contracts starts at about 6 minute mark) <a href="https://www.youtube.com/watch?v=pA6CGuXEKtQ">https://www.youtube.com/watch?v=pA6CGuXEKtQ</a></p> <p>Layer 2, and the Lightning Network <a href="https://dci.mit.edu/lightning-network">https://dci.mit.edu/lightning-network</a></p>
			<p><b>Optional</b></p> <p>Illustrated guide to Ethereum <a href="https://www.abra.com/resources/worlds-computer/">https://www.abra.com/resources/worlds-computer/</a></p>

			<p>Introduction to Solidity, the language of smart contracts on Ethereum  <a href="https://www.geeksforgeeks.org/introduction-to-solidity/">https://www.geeksforgeeks.org/introduction-to-solidity/</a></p> <p>Solidity by example (voting)  <a href="https://docs.soliditylang.org/en/v0.8.9/solidity-by-example.html">https://docs.soliditylang.org/en/v0.8.9/solidity-by-example.html</a></p> <p>(Article) Introduction to Smart Contracts (Solidity. For Developers)  <a href="https://docs.soliditylang.org/en/v0.8.9/introduction-to-smart-contracts.html">https://docs.soliditylang.org/en/v0.8.9/introduction-to-smart-contracts.html</a></p> <p>Some blockchain projects improve certain properties over the bitcoin original design. One such type is a Payment Channel Network and one example of such is the Bitcoin Lightning Network. These networks may be susceptible to new attack types as well.  <a href="https://arxiv.org/abs/2007.09047">[2007.09047] Exploiting Centrality: Attacks in Payment Channel Networks with Local Routing</a>  <a href="https://arxiv.org/abs/2007.09047">https://arxiv.org/abs/2007.09047</a></p> <p><i>Decentralized Finance</i>  Crypto Banking and Decentralized Finance, Explained  <a href="https://www.nytimes.com/2021/09/05/us/politics/cryptocurrency-explainer.html">https://www.nytimes.com/2021/09/05/us/politics/cryptocurrency-explainer.html</a>  And  <a href="https://ethereum.org/en/defi/">https://ethereum.org/en/defi/</a></p>
5	9 – 23	<p>NFTs and Ethereum ERC-721 Tokens</p> <p>Stablecoins and other ERC-20 Tokens</p> <p>Decentralized Finance (DeFi)</p> <p><i>Begin discussion of Societal Impacts.</i></p> <ul style="list-style-type: none"> <li>- The promise vs. the practice</li> <li>- Energy Usage</li> <li>- Crypto Exchanges</li> <li>- Cybersecurity Considerations</li> <li>- Illicit Content</li> <li>- Money laundering</li> </ul>	<p><i>NFTs</i></p> <ul style="list-style-type: none"> <li>• NFTs, explained   MIT CSAIL  <a href="https://www.csail.mit.edu/news/nfts-explained">https://www.csail.mit.edu/news/nfts-explained</a>  Or  What are NFTs  <a href="https://www.nytimes.com/interactive/2022/03/18/technology/nft-guide.html">https://www.nytimes.com/interactive/2022/03/18/technology/nft-guide.html</a></li> <li>• The untold story of the NFT boom  <a href="https://www.nytimes.com/2021/05/12/magazine/nft-art-crypto.html">https://www.nytimes.com/2021/05/12/magazine/nft-art-crypto.html</a></li> </ul> <p><i>Stablecoins</i></p> <ul style="list-style-type: none"> <li>• Stablecoins and the Future of Money  <a href="https://hbr.org/2021/08/stablecoins-and-the-future-of-money">https://hbr.org/2021/08/stablecoins-and-the-future-of-money</a></li> </ul>

- The Technology Underlying Stablecoins  
<https://nehanarula.org/2021/09/23/stablecoins.html>

*DeFi*

Crypto Banking and Decentralized Finance, Explained  
<https://www.nytimes.com/2021/09/05/us/politics/cryptocurrency-explainer.html>

**Optional**

Narayanan - ch. 6 Bitcoin and Anonymity, page 165 - 169  
6.1 anonymity basics

*Mining (Theory vs Practice)*

The Evolution of Bitcoin Hardware  
[https://michaeltaylor.org/papers/Taylor\\_Bitcoin\\_IEEE\\_Computer\\_2017.pdf](https://michaeltaylor.org/papers/Taylor_Bitcoin_IEEE_Computer_2017.pdf)

*Illicit Content*

Does regulation of illegal content need reconsideration in light of blockchains? By Maurice Schellekens, *International Journal of Law and Information Technology*, Volume 27, Issue 3, Autumn 2019, Pages 292–305,  
<https://academic.oup.com/ijlit/article/27/3/292/5601120>

*Energy Usage*

- Cambridge Bitcoin Electricity Consumption Index (CBECI) <https://cbeci.org/>
- Proof of Stake (PoS)  
Energy consumption of the leading PoS DLTs?  
<http://blockchain.cs.ucl.ac.uk/blockchain-energy-consumption/>
- And <https://spectrum.ieee.org/ethereum-plans-to-cut-its-absurd-energy-consumption-by-99-percent>

*Cybersecurity*

(Article) [Ethereum's smart contracts are full of holes](https://www.technologyreview.com/2018/03/01/144962/ethereums-smart-contracts-are-full-of-holes/) (MIT Technology Review)  
<https://www.technologyreview.com/2018/03/01/144962/ethereums-smart-contracts-are-full-of-holes/>

Known Attacks - Ethereum Smart Contract Best Practices

			<p><a href="https://ethereum-contract-security-techniques-and-tips.readthedocs.io/en/latest/known_attacks/">https://ethereum-contract-security-techniques-and-tips.readthedocs.io/en/latest/known_attacks/</a></p> <p><i>Money Laundering</i>  <a href="https://www.forbes.com/sites/billybambrough/2020/05/28/new-york-hacker-charged-in-100-million-dollar-bitcoin-case/#1f3d050ac90e">New York Man Charged In \$100 Million Bitcoin Case</a> (Forbes) money laundering with bitcoin  <a href="https://www.forbes.com/sites/billybambrough/2020/05/28/new-york-hacker-charged-in-100-million-dollar-bitcoin-case/#1f3d050ac90e">https://www.forbes.com/sites/billybambrough/2020/05/28/new-york-hacker-charged-in-100-million-dollar-bitcoin-case/#1f3d050ac90e</a></p> <p>OFAC, the DPRK and the Tornado of Cash by Nicholas Weaver <a href="https://www.lawfareblog.com/ofac-dprk-and-tornado-cash">https://www.lawfareblog.com/ofac-dprk-and-tornado-cash</a></p> <p><i>Exchanges</i>  Ponzi Schemes, Private Yachts, and a Missing \$250 Million in Crypto: The Strange Tale of Quadriga  <a href="https://www.vanityfair.com/news/2019/11/the-strange-tale-of-quadriga-gerald-cotten">https://www.vanityfair.com/news/2019/11/the-strange-tale-of-quadriga-gerald-cotten</a></p> <p>Binance Exchange Outages  <a href="https://www.cnbc.com/2021/08/19/cryptocurrency-traders-seek-damages-from-binance-after-major-outage.html">https://www.cnbc.com/2021/08/19/cryptocurrency-traders-seek-damages-from-binance-after-major-outage.html</a></p> <p>Crypto Exchanges  <a href="https://www.nbcnews.com/tech/security/bitcoin-crypto-exchange-hacks-little-anyone-can-do-rcna7870">https://www.nbcnews.com/tech/security/bitcoin-crypto-exchange-hacks-little-anyone-can-do-rcna7870</a></p> <p>Why Bitcoin is bullshit, explained by an expert  <a href="https://www.vox.com/conversations/2018/4/11/17206018/bitcoin-blockchain-cryptocurrency-weaver">https://www.vox.com/conversations/2018/4/11/17206018/bitcoin-blockchain-cryptocurrency-weaver</a></p>
6	9 - 30	Governance DAO NFT Continued (as needed) Digital & Fractional Ownership Voting Impacts & Criticisms	<p><b><i>check Canvas for Final Assigned Readings</i></b></p> <p>The complexity and arbitrariness of non-fungible tokens (NFTs) are a big part of their appeal.  <a href="#">NFTs Show the Value of Owning the Unownable - The Atlantic.pdf</a></p> <p>Crypto Banking and Decentralized Finance, Explained - <a href="https://www.nytimes.com/2021/09/05/us/politics/cryptocurrency-explainer.html">https://www.nytimes.com/2021/09/05/us/politics/cryptocurrency-explainer.html</a></p> <p>DeFi explained by SEC</p>

			<p><a href="https://www.sec.gov/news/statement/crenshaw-defi-20211109">https://www.sec.gov/news/statement/crenshaw-defi-20211109</a></p> <p><i>Impacts &amp; Criticisms</i>  (Video)(30 min) “Burn it with Fire”  by Nicholas Weaver, International Computer Science Institute (ICSI) and University of California, Berkeley at USENIX  <a href="https://www.youtube.com/watch?v=MQDKMe6MDXQ">https://www.youtube.com/watch?v=MQDKMe6MDXQ</a></p> <p>The complete argument against Crypto by Software Engineer Stephen Diehl  <a href="https://www.stephendiehl.com/blog/complete.html">https://www.stephendiehl.com/blog/complete.html</a></p>
			<p><b>Optional</b>  Introduction: What is Web3?  <a href="https://www.nytimes.com/interactive/2022/03/18/technology/web3-definition-internet.html">https://www.nytimes.com/interactive/2022/03/18/technology/web3-definition-internet.html</a></p> <p>Review a few abstracts from “Web3 is doing great”  <a href="https://web3isgoinggreat.com/">https://web3isgoinggreat.com/</a></p> <p>Attacking the DeFi Ecosystem with Flash Loans for Fun and Profit -  <a href="https://hackingdistributed.com/2020/03/11/flash-loans/">https://hackingdistributed.com/2020/03/11/flash-loans/</a></p>
7	10 – 7	<p>Applications of Blockchain in other industry?</p> <p>Private Ledger Consortiums</p> <p>Central Bank Digital Currency (CBDC)</p> <p>Regulatory Discussions</p> <p>Emerging Risks</p> <p>Metaverse</p>	<p>Systemic Risk  <a href="https://www.reuters.com/breakingviews/crypto-poses-systemic-risks-that-need-swift-remedy-2021-09-07/">https://www.reuters.com/breakingviews/crypto-poses-systemic-risks-that-need-swift-remedy-2021-09-07/</a></p> <p><i>Central Bank Digital Currency (CBDC)</i>  The federal reserve is considering a CBDC  <a href="https://time.com/nextadvisor/investing/cryptocurrency/expert-reaction-to-fed-digital-currency-report/">https://time.com/nextadvisor/investing/cryptocurrency/expert-reaction-to-fed-digital-currency-report/</a></p> <p><i>ICO Failures</i>  Nearly Half of 2017's Bitcoin-Backed 'ICO' Projects Have Collapsed - \$233 million in funding raised through ICOs has vanished.  <a href="https://fortune.com/2018/02/25/cryptocurrency-ico-collapse/">https://fortune.com/2018/02/25/cryptocurrency-ico-collapse/</a></p> <p>Crypto Is Down, So Why Am I Smiling? By Dr. Stornetta</p>

			<a href="https://www.coindesk.com/crypto-is-down-so-why-am-i-smiling">https://www.coindesk.com/crypto-is-down-so-why-am-i-smiling</a>  What Is the Metaverse, Exactly? <a href="https://www.wired.com/story/what-is-the-metaverse/">https://www.wired.com/story/what-is-the-metaverse/</a>
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**BELOW ARE MORE OPTIONAL READINGS. These may be helpful for final project sources as well**

		Philosophy and Nuances of Trust  Other 'types' of Blockchains  Public vs. Private	<a href="#">Blockchain and Trust</a> by Bruce Schneier <a href="https://www.schneier.com/blog/archives/2019/02/blockchain_and_.html">https://www.schneier.com/blog/archives/2019/02/blockchain_and_.html</a>  <a href="#">How the NSA (may have) put a backdoor in RSA's cryptography: A technical primer</a> <a href="https://blog.cloudflare.com/how-the-nsa-may-have-put-a-backdoor-in-rsas-cryptography-a-technical-primer/">https://blog.cloudflare.com/how-the-nsa-may-have-put-a-backdoor-in-rsas-cryptography-a-technical-primer/</a>  <a href="#">Types of Blockchains &amp; DLTs (Distributed Ledger Technologies)</a> <a href="https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/">https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/</a>
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		Property Discussions  Code is Law ideas  Uses of ERC-721, NFTs to track 'property rights'?	Art Market and NFTs <a href="https://www.nytimes.com/2022/04/14/arts/design/nft-art-market-sothebys.html">https://www.nytimes.com/2022/04/14/arts/design/nft-art-market-sothebys.html</a>  Whitaker, Amy, and Roman Kräussl. <a href="#">Blockchain, Fractional Ownership, and the Future of Creative Work</a> <i>Available at SSRN 3100389</i> (2019). <a href="https://www.econstor.eu/bitstream/10419/182451/1/1031263918.pdf">https://www.econstor.eu/bitstream/10419/182451/1/1031263918.pdf</a>  <a href="#">Art and Blockchain</a> (Article, Artivate.org) A Primer, History, and Taxonomy of Blockchain Use Cases in the Arts <a href="https://artivate.org/artivate/article/view/94">https://artivate.org/artivate/article/view/94</a>  <i>Defining Property in the Digital Environment, Bitmark Inc.</i> By Casey Alt, Sean Moss-Pultz, Amy Whitaker, & Timothy Chen (26 min read)(PDF on Canvas)  A Mid-Year Review of the art market 2021 (Basel) <a href="https://d2u3kfwd92fzu7.cloudfront.net/The_Art_Market_Mid-Year_Review_2021.pdf">https://d2u3kfwd92fzu7.cloudfront.net/The_Art_Market_Mid-Year_Review_2021.pdf</a>
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			<p>Boom or bubble: how sustainable is the recent success of the online art trade? (Part 3)  <a href="https://www.hiscox.co.uk/sites/default/files/documents/2021-04/hoatr_report_2020_part3.pdf">https://www.hiscox.co.uk/sites/default/files/documents/2021-04/hoatr_report_2020_part3.pdf</a></p>
		<p>Industry Applications</p> <p>Regulations</p> <p>Alternate views</p>	<p><a href="https://hbr.org/2017/04/who-controls-the-blockchain">Who Controls the Blockchain?</a>  <a href="https://hbr.org/2017/04/who-controls-the-blockchain">https://hbr.org/2017/04/who-controls-the-blockchain</a></p> <p><a href="https://theconversation.com/can-blockchain-a-swiftly-evolving-technology-be-controlled-73471">Can blockchain, a swiftly evolving technology, be controlled?</a> (Article)  <a href="https://theconversation.com/can-blockchain-a-swiftly-evolving-technology-be-controlled-73471">https://theconversation.com/can-blockchain-a-swiftly-evolving-technology-be-controlled-73471</a></p> <p><a href="https://firstmonday.org/ojs/index.php/fm/article/view/71113/657">View of Blockchain technology as a regulatory technology: From code is law to law is code</a>  <a href="https://firstmonday.org/ojs/index.php/fm/article/view/71113/657">https://firstmonday.org/ojs/index.php/fm/article/view/71113/657</a></p> <p>Crypto Is Down, So Why Am I Smiling? By Dr. Stornetta  <a href="https://www.coindesk.com/crypto-is-down-so-why-am-i-smiling">https://www.coindesk.com/crypto-is-down-so-why-am-i-smiling</a></p> <p>'Blockchain' is meaningless (TheVerge)  <a href="https://www.theverge.com/2018/3/7/17091766/blockchain-bitcoin-ethereum-cryptocurrency-meaning">https://www.theverge.com/2018/3/7/17091766/blockchain-bitcoin-ethereum-cryptocurrency-meaning</a></p> <p>What's Blockchain Actually Good for, Anyway? For Now, Not Much  <a href="https://www.wired.com/story/whats-blockchain-good-for-not-much/">https://www.wired.com/story/whats-blockchain-good-for-not-much/</a></p> <p>Podcast Why Everybody Who Doesn't Hate Bitcoin Loves It (Ep. 160) (freakonomics radio)  <a href="https://freakonomics.com/podcast/why-everybody-who-doesnt-hate-bitcoin-loves-it-a-new-freakonomics-radio-podcast/">https://freakonomics.com/podcast/why-everybody-who-doesnt-hate-bitcoin-loves-it-a-new-freakonomics-radio-podcast/</a></p>
		<p>Emerging Applications of Blockchain in industry</p> <p>Formulating Research Questions</p> <p>Agriculture (Food traceability).</p> <p>Blockchain for COVID</p> <ul style="list-style-type: none"> <li>- COVID-19 has had a transformative effect on many workplaces, markets, and</li> </ul>	<p><a href="https://www.wsj.com/articles/a-cryptocurrency-technology-finds-new-use-tackling-coronavirus-11587675966">A Cryptocurrency Technology Finds New Use Tackling Coronavirus</a>  <a href="https://www.wsj.com/articles/a-cryptocurrency-technology-finds-new-use-tackling-coronavirus-11587675966">https://www.wsj.com/articles/a-cryptocurrency-technology-finds-new-use-tackling-coronavirus-11587675966</a></p> <p><a href="https://www.forbes.com/sites/nishandegnarain/2020/03/22/5-ways-blockchain-can-unblock-the-coronavirus-medical-supply-chain/">Five Ways Blockchain Can Unblock The Coronavirus Medical Supply Chain</a>  <a href="https://www.forbes.com/sites/nishandegnarain/2020/03/22/5-ways-blockchain-can-unblock-the-coronavirus-medical-supply-chain/">https://www.forbes.com/sites/nishandegnarain/2020/03/22/5-ways-blockchain-can-unblock-the-coronavirus-medical-supply-chain/</a></p>

		<p>businesses today.</p> <ul style="list-style-type: none"> <li>- Can blockchain models be used to solve new problems encountered by global disruptions to traditional supply chains?</li> <li>- Can Blockchain provide solutions to emerging COVID-19 related challenges?</li> <li>- What traditional modes of societal interaction or traditional business models have been less resilient than we hoped?</li> </ul> <p>Thoughts on the future.</p>	<p><a href="https://www.coindesk.com/how-blockchain-tech-can-make-coronavirus-relief-more-effective">Blockchain Can Bring Transparency To Coronavirus Response</a>  <a href="https://www.coindesk.com/how-blockchain-tech-can-make-coronavirus-relief-more-effective">https://www.coindesk.com/how-blockchain-tech-can-make-coronavirus-relief-more-effective</a></p> <p><a href="https://fortune.com/2020/07/07/blockchain-technology-regulation-coronavirus-economy/">Overstock CEO: How blockchain can help pull us out of the coronavirus recession</a> Article in Fortune Magazine  <a href="https://fortune.com/2020/07/07/blockchain-technology-regulation-coronavirus-economy/">https://fortune.com/2020/07/07/blockchain-technology-regulation-coronavirus-economy/</a></p> <p><a href="https://www.pma.com/content/articles/blockchain">Blockchain: What It Is, What It Isn't, and What It Means for The Produce Industry</a>  <a href="https://www.pma.com/content/articles/blockchain">https://www.pma.com/content/articles/blockchain</a></p> <p><a href="https://www.ibm.com/blockchain/solutions/food-trust">IBM Food Trust - Blockchain for the world's food supply</a>  <a href="https://www.ibm.com/blockchain/solutions/food-trust">https://www.ibm.com/blockchain/solutions/food-trust</a>  and  <a href="https://www.thepacker.com/article/brightfarms-adds-blockchain-tech-through-ibm-food-trust-network">BrightFarms adds blockchain tech through IBM Food Trust Network</a> (BrightFarms is now in 2000 stores)  <a href="https://www.thepacker.com/article/brightfarms-adds-blockchain-tech-through-ibm-food-trust-network">https://www.thepacker.com/article/brightfarms-adds-blockchain-tech-through-ibm-food-trust-network</a></p> <p><a href="https://www.thepacker.com/article/produce-industry-keeping-tabs-blockchain">Produce industry keeping tabs on blockchain   Packer</a>  <a href="https://www.thepacker.com/article/produce-industry-keeping-tabs-blockchain">https://www.thepacker.com/article/produce-industry-keeping-tabs-blockchain</a></p> <p><a href="https://www.thepacker.com/article/california-giant-blockchain-use-boosts-freshness-food-safety">California Giant blockchain use boosts freshness, food safety</a>  <a href="https://www.thepacker.com/article/california-giant-blockchain-use-boosts-freshness-food-safety">https://www.thepacker.com/article/california-giant-blockchain-use-boosts-freshness-food-safety</a></p>
			<p><i>More on Stablecoins (Optional)</i></p> <p>What are stablecoins? A blockchain expert explains  <a href="https://theconversation.com/what-are-stablecoins-a-blockchain-expert-explains-164812">https://theconversation.com/what-are-stablecoins-a-blockchain-expert-explains-164812</a>  And  Why Washington Worries About Stablecoins  <a href="https://www.nytimes.com/2021/09/17/business/economy/federal-reserve-virtual-currency-stablecoin.html">https://www.nytimes.com/2021/09/17/business/economy/federal-reserve-virtual-currency-stablecoin.html</a></p>



			<p>UnTethered <a href="https://slate.com/technology/2021/10/tether-crypto-danger-ben-mckenzie.html">https://slate.com/technology/2021/10/tether-crypto-danger-ben-mckenzie.html</a></p> <p>PWGR on Stablecoins <a href="https://www.sec.gov/news/statement/gensler-statement-presidents-working-group-report-stablecoins-110121">https://www.sec.gov/news/statement/gensler-statement-presidents-working-group-report-stablecoins-110121</a></p> <p><a href="https://www.nytimes.com/2013/05/29/nyregion/liberty-reserve-operators-accused-of-money-laundering.html">Liberty Reserve Operators Accused of Money Laundering (\$6 Billion)</a> <a href="https://www.nytimes.com/2013/05/29/nyregion/liberty-reserve-operators-accused-of-money-laundering.html">https://www.nytimes.com/2013/05/29/nyregion/liberty-reserve-operators-accused-of-money-laundering.html</a></p> <p>How a \$300K Bored Ape Yacht Club NFT accidentally sold for \$3K <a href="https://www.cnet.com/news/how-a-300k-bored-ape-yacht-club-nft-was-accidentally-sold-for-3k/">https://www.cnet.com/news/how-a-300k-bored-ape-yacht-club-nft-was-accidentally-sold-for-3k/</a></p> <p><a href="#">Why Johnny Can't Encrypt</a> This paper was originally published in the Proceedings of the 8th USENIX Security Symposium (Washington, D.C., Aug. 23–36, 1999), 169–184 <a href="https://people.eecs.berkeley.edu/~tygar/papers/Why_Johnny_Cant_Encrypt/OReilly.pdf">https://people.eecs.berkeley.edu/~tygar/papers/Why_Johnny_Cant_Encrypt/OReilly.pdf</a></p>
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