SIGecom Winter Meeting 2023 Highlights

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The third annual ACM SIGecom Winter Meeting took place on February 22, 2023. Organized by Scott Kominers and Matt Weinberg, this year's meeting brought together researchers from economics, computer science, and adjacent fields to focus on Web3, blockchains, and cryptocurrencies. The virtual meeting included talks from and discussions with leading experts on getting into the research space, interesting technical questions, and exciting challenges and opportunities that lie ahead. The day also included interactive exercises that gave participants the opportunity to gain hands-on experience and have fun with NFTs.

Here, we share some highlights and insights from the 2023 Winter Meeting.

Web3: What and why?

The first session of the day was an introduction designed to give everyone the necessary background for the rest of the program, addressing the question: *what* is

blockchain/Web3? The workshop then moved into a more technical panel discussion hoping to answer the question: *why* think about blockchain/Web3?

What: Intro to blockchain and web3

We are increasingly hearing that blockchains are a new and exciting topic at the intersection of economics, computation, and algorithmic game theory. ChatGPT even tells us that Web3 represents "the next evolution of the internet." But, what exactly *is* a blockchain? To help answer this question, Jacob Leshno began with a presentation intriguingly titled *Blockchain, web3, the promise of decentralization, and soup.* In this primer on blockchains and Web3, Jacob set out to help participants understand the fundamentals of these technologies – what they are, what they are supposed to be, and what they could become.

Jacob suggested that underneath all the hype, expectations, and vague promises to make life amazingly decentralized (and simply *better*), a blockchain is fundamentally an idealized "computer in the sky" – a system to provide trusted storage of data and execution of code, open to all users and not controlled or owned by any single user. This can be implemented using an open write-only ledger, which allows users to commit via automated execution of code (known as "smart contracts").

So if this magical computer in the sky can be implemented reasonably efficiently, why hasn't it solved all our problems already?

It turns out that the barriers to decentralization are often not due to the computer itself, but rather the larger legal, political, and social environments in which it operates. Consider the tragic tale of the cryptobros who tried to buy a rare *Dune* book and convert it into NFTs, only to learn that $3 million could get them a very expensive copy but not the actual rights to the book – since intellectual property is governed by the US courts, not code on a blockchain.[1] And copyright law is just one such instance within a sociopolitical structure that concentrates power and resources in centralized institutions.

What, then, is the secret sauce that blockchain provides to tackle these issues? Or is it just the stone in the proverbial stone soup,[2] contributing only in name but not in substance to an elaborate mixture that we've thrown together?[3]

Either way, Jacob argues that there are still many reasons to be excited about blockchains. Even if blockchains/Web3 are not the end-all be-all solution, they still draw attention to important legal, economic, and financial questions. Re-examining these systems may then lead to broader impacts on products and markets: For example, how will large financial corporations adapt to a world where individual users can perform basic services on the blockchain on their own? And what implications will this have on preserving competition, openness, and fairness? Last but not least, on the technical side, open decentralized protocols have numerous interesting properties that may have the potential to solve other types of problems as well.

The rest of the presentation explored these points in further depth, using Bitcoin as a running example. Fundamentally, a payment system should store user balances and allow legal transfers. The traditional solution of a centralized operator makes

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[1] https://www.esquire.com/entertainment/books/a38815538/dune-crypto-nft-sale-mistake-explained/
[2] https://en.wikipedia.org/wiki/Stone_Soup
[3] And on this note, the promised titular soup was indeed delivered.

this easy, but requires institutional trust, allows for monopolies that can harm welfare, and is vulnerable to hold-up problems. As a decentralized payment system, the Bitcoin protocol aims to address these problems. In contrast to a *platform* with a centralized planner, the term *protocol* suggests a *market-based* approach, where miners provide the infrastructure so that users can obtain services, and anyone can be a miner or a user. Some of the challenges faced by such a decentralized system include validating transfers and ensuring consistency in the presence of nodes that may fail or be malicious, while avoiding control by a single monopolist. By combining tools from cryptography (digital signatures for authentication) and distributed systems (BFT consensus algorithms), Bitcoin's Nakamoto protocol provides a solution for processing transactions.

To close, Jacob gave a sampling of a few directions for future work. Systems-level questions include optimizing protocols for efficiency, security, and scalability. The design of systems and protocols also inherently involves game-theoretic questions, such as handling collusion between users and miners. Finally, there are broader organizational questions of how blockchain/Web3 can be incorporated into markets, economies, and other structures to create new societal systems to be studied.

With the market-based view of protocols, it is clear that tools from market design will be essential moving forward. Ultimately, Jacob proposed thinking of blockchains as a new paradigm combining elements of open-source software and market design, drawing an active community of researchers from a wide range of fields together to ask and answer many exciting questions.

Why: Panel discussion on interesting questions and challenges

In the panel with Barnabé Monnot, Andrés Monroy-Hernández, and Elaine Shi, we took a deeper dive into some of these exciting questions.

The panelists started off by sharing their paths to the blockchain community. **Barnabé**'s academic roots are in the EC community, having focused on algorithmic game theory and systems during his PhD. A key moment was when he attended Devcon (the Ethereum Foundation's annual conference) in 2018, where he was so energized by many conversations that he decided he wanted to work full-time for the Ethereum Foundation. **Andrés** comes from a background in Human-Computer Interaction and social computing, and is interested in systems that enable new forms of collaboration. He first started thinking about blockchains at Snapchat, exploring the creation and monetization of digital content on the blockchain. **Elaine**'s background is in systems security and cryptography. She first started working on distributed consensus protocols during the early days of Bitcoin, and became intrigued by how the incentive design of the protocol encouraged early adopters.

Next, each panelist shared one key aspect that they find interesting about the Web3 space. **Barnabé** is interested in the democratization of mechanism design, as blockchains emphasize putting the tools of mechanism design in the hands of users rather than only the platforms. On a similar note, **Andrés** feels that blockchain technologies may transform the underlying infrastructure of online societies by shifting the locus of power from a few to many. **Elaine** noted that she was initially drawn in by the technical challenges, but she has remained an active member of the blockchain community because of its truly interdisciplinary nature, and its unique eagerness to deploy state-of-the-art academic research in the real world.

Each panelist was then asked for one area in which they see blockchains having a tangible impact within the next few years. **Barnabé** noted that impact is not even necessarily a few years away, but is already being made now, for instance, through the huge market cap of Bitcoin and NFTs. **Elaine** highlighted more far-reaching economic implications, such as antitrust regulation and removing monopolies. **Andrés** focused on the popularization of DAOs (decentralized autonomous organizations) as an alternative to incompetent, corrupt, and/or otherwise dysfunctional institutions.

Then, each panelist shared a research direction of interest to the EC community. **Elaine** pointed to decentralized mechanism design – how does the feasibility landscape change with the challenges of a decentralized setting (in which many classical solutions completely fail), but with the help of tools from cryptography? And in addition to incentive compatibility and collusion resistance, what about maximizing welfare, revenue, and other objectives? **Barnabé** highlighted questions about the credibility of auctioneers in decentralized environments, as well as the ecosystem of MEV (miner/maximal extractable value, a broad term referring to the positive and negative externalities arising from multiple users having conflicting goals on shared state machines) – how can MEV be managed, mitigated, captured, and/or utilized? **Andrés** brought up new questions in market design, particularly in three-sided marketplaces (*e.g.*, food delivery systems, with restaurants, drivers, and customers). How can we better design systems with multiple stakeholders and both short- and long-term incentives in mind, and what implications might this have on cooperative ownership, competition, and other dynamics?

To close, the panelists each shared one thing they love most about the blockchain community, one thing they like the least, and concrete suggestions for students and researchers hoping to learn more about the space. **Barnabé** loves how open the community is to new people, feedback, and ideas. **Andrés** loves the new optimism and excitement around the opportunity to start from scratch and reimagine the organizations, platforms, institutions that we have today with an angle of social justice. **Elaine** loves the eagerness to deploy SOTA research, which is a key driving force in making advances in areas ranging from zero knowledge proofs to formal verification and mechanism design. The panelists all expressed frustration at confusing, opaque, and overly financialized systems that have left room for bad actors. In light of this, they emphasized connecting with leaders and mentors for energy, inspiration, and guidance in navigating the complex blockchain space. In particular, **Barnabé** recommended reaching out both at in-person events and online; **Andrés** pointed to resources such as The Blockchain Socialist podcast and SIGCHI papers; and **Elaine** highlighted workshops that bring together academic and industry researchers in an intimate setting (such as this Winter Meeting!).

Overall, the panel concluded on a note of cautious excitement – while blockchains and Web3 may not be the *only* solution to *all* our problems, they are certainly an fascinating path toward exploring technical foundations, socioeconomic dynamics, and other interdisciplinary questions running through our society.

Fireside chat with Tim Roughgarden

In the early afternoon, there was a fireside chat with Tim Roughgarden. Tim is head of research at a16z crypto and Professor of Computer Science at Columbia University. Much of the Q&A centered around three apparent pivots in his career (spoiler: He views them not actually as pivots, but as natural transitions guided by his research interests), followed by his visions for the growth of the blockchain space. Below are some edited excerpts from the Q&A with Tim.

"Pivot" 1: Blockchains and Web3. **You were working on game theory and mechanism design for many years. What caused the pivot to blockchains?**

That's a question I get a lot. I can see how from the outside this may seem like a pivot, but from my perspective, it feels like a very natural segue. I'm still doing research in theoretical computer science, which is my core training. When I was a Ph.D. student at Cornell in the late 90s, the internet was blowing up, which drove a lot of important research in computer science. It was also clear that computer scientists needed to learn game theory to reason about applications arising on the internet. Now, as someone who works on foundational computer science in areas that are less well-understood and involve game-theoretic reasoning, blockchains are a very natural application. The economic issues are intertwined with the technology in a more intrinsic way than I've ever seen before. There are so many opportunities for computer scientists who do mechanism design and economic theory, and it's a perfect fit for me as a lifelong EC person, and for this community.

In addition, I would say Web3 is not just a branch of mechanism design, but an entirely new discipline in computer science unfolding in front of our eyes. It's unbelievably interdisciplinary – drawing from classical ideas in consensus and cryptography and mechanism design. In many ways, doing Web3 research now feels similar to when I worked on algorithmic game theory for the internet in the 2000s. It felt like a new area. Everybody working on it seemed very confused. We made a lot of mistakes. We reinvented the wheel a bunch of times. There were no textbooks or lecture notes written for computer scientists. But on the other hand, if you want to do research that will show up in textbooks, working in an area that doesn't yet have textbooks is a great way to achieve that.

"Pivot" 2: The application layer. **Can you tell us more about your work at the application layer? Automated market makers (AMMs) and decentralized finance (DeFi) seem like a bit of a pivot–what happened there?**

The work on DeFi and AMMs also doesn't feel like as much of a pivot to me. As a theoretician, I'm unusually agnostic about the techniques I use; ultimately, I am more of a problem-driven person. My research agenda is shaped by questions like *what systems and applications do I want to understand? What is the type of math that is appropriate?* Given my focus on Web3, it's natural to study AMMs.

One of the things that blockchains bring about are questions about the rules of ownership and exchange. In the centralized world, this is well-solved by traditional finance. However, as a "computer in the sky," the blockchain is quite weak (maybe as powerful as a computer 50-60 years ago), so you have to limit yourself to very simple computations (e.g., order books are prohibitively expensive). A lightweight alternative is automated market makers (AMMs), actually originally developed for

prediction markets to address liquidity issues. In analyzing these alternatives, it was interesting to look at new types of math not necessarily as familiar to the EC community (e.g., continuous-time finance, Black-Scholes, etc.).

"Pivot" 3: a16z and transition between academia and industry. **What has working at a16z been like? What are you trying to accomplish there?**

When I was asked to start a crypto research lab at a16z, I couldn't pass on such an incredibly unique opportunity. Researchers at a16z crypto devote about two-thirds of their time to fundamental academic work, with the remaining third collaborating with portfolio companies on super early-stage products, through which it is much easier to have immediate direct impact. Talking with real-world practitioners also reveals fundamental challenges, limitations, and possibilities, helping to identify promising research directions.

What are my hopes for the legacy of it all? I would love if, in hindsight, the a16z lab comes to be viewed as an "inflection point" in two senses: first, as a nudge towards mainstream adoption of crypto and blockchains; and second, as a milestone for Web3 to be viewed as a hard and fascinating area of computer science, and a serious academic discipline.

Let's say I'm a student and I'm sold! But as you said, it's hard to find problems because the field moves so fast. What problems do you see right now that you'd love to see more students working on?

First, a few practical points of advice: If you're starting out, say a first- or second-year Ph.D. student, find a mentor who's more calibrated to the field than you are. They don't necessarily have to be your Ph.D. advisor or at your home institution: they could come from industry, or be a more senior grad student. It's also worth monitoring the literature (e.g., setting arXiv alerts for keywords like MEV). Some papers will be super convincing and exciting! Some will feel like something's missing, and you can ask yourself what you thought was missing and sit down and write that theorem or paper.

More generally, here are some trends that we need to understand better:

(1) Macroeconomic effects of mechanism design: Traditionally, the EC community has focused on game theory and microeconomics, but now, a blockchain's protocol can directly access and manipulate its entire financial ecosystem. What are the consequences of our mechanism design choices on tokenomics, inflation, and other broad economic outcomes?

(2) Incentives at the L1 layer (the base network): What can be accomplished by fundamental design decisions (*e.g.*, Ethereum's recent switch from PoW to PoS)? Can the intuition behind these design decisions be supported by theory?

(3) The application layers: How are the incentive properties of the base network carried through to applications built on this foundation? What properties arise from economic interactions between different layers of the blockchain stack?

(4) A unified theory of AMMs: Are some AMMs "better" than others? What is the "right" objective function to optimize?

(5) MEV: Can we develop a standardized vocabulary and theory to describe this very broad phenomenon?

Social activity: Mint your own NFT!

During a 15-minute break, Matt and Scott invited every member of the audience to mint a real NFT of their own. Participants who did not already own a crypto wallet could create one on MetaMask (Matt and Scott provided a direct link to the official website, to avoid scams or phishing websites from search engines), a web browser extension and mobile app that manages users' Ethereum private keys. Creating a wallet involves the generation of a *seed phrase*, or a top secret sequence of words that can be used to access the contents of the wallet. Matt and Scott advised the audience to write down several copies of their seed phrase (by hand!) to store securely in different locations, but *never* to screenshot or type directly into a computer.[4]

After everyone had created their crypto wallet, MetaMask displayed the asset on the Ethereum blockchain (initially 0, since nobody had yet minted a token) with options to buy, send, and swap cryptocurrencies. Then, when participants scanned a provided QR code, they were taken to the POAP website (Proof of Attendance Protocol, a type of NFT). By minting their own POAP, everyone was able to immortalize their attendance at the 2023 SIGecom Winter Meeting to live on the blockchain forever!

NFT case study: Bored Ape Yacht Club

If you could have had the option of buying a Bored Ape NFT in the initial sale at 0.08 ETH, would you have done so? If you had one today (market "floor" price currently around 75 ETH), would you sell it? Rather than leaping at this appealingly massive value increment presented to them, workshop participants generally voiced uncertainty. Why would anyone be willing to spend millions of dollars on an NFT? Just what exactly are they buying, other than a picture on the internet? How could an internet token really be "worth" such an amount of money? And what does it even mean to "own" an NFT? These questions formed a launching point for an interactive discussion led by Scott Kominers, using the Bored Ape Yacht Club (BAYC) NFTs as a lens to demystify this new class of digital deed.

What does it mean to "own a BAYC NFT"? A BAYC NFT is a blockchain record associated with a unique ape image claiming that a crypto wallet is its current owner, which is used to certify ownership. From the viewpoint of a traditional art market, NFT owners are paying for the image of the ape. While it may seem insane to pay millions of dollars for a mere picture, Scott argued that the digital image itself does indeed hold some functional value. Perhaps the foremost are intellectual property (IP) rights and use rights derived from ownership – BAYC holders are granted full commercial usage rights to any of the ape images they own. In addition, the images draw attention and visibility to this exclusive property right, making the abstract concept of ownership more tangible and attractive. For instance, the "Mutant Serum" airdrop allowed owners of Bored Ape images to create new mutant-inspired NFTs, representing a additional level of exclusive membership in the club.

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[4]To recover a wallet, the seed phrase is generally entered by selecting each word one at a time from a larger set of words.

However, most participants remained unconvinced that people would pay a small fortune simply to digitally "own" a picture of an ape with anonymous creators. Scott then invited the audience to brainstorm other values that might contribute to the demand for NFTs. One suggestion was that similar to investing in cryptocurrencies, people might believe that NFTs are a good investment that could significantly increase in value in the future. Another idea was that NFTs derive value from the social status that they confer upon their owners.

In addition to these potential factors contributing to the success of BAYC NFTs, Scott highlighted the community built around the Bored Ape collection. Essentially, a BAYC NFT is equivalent to a membership card of the community, which grants holders access to a members-only section of the BAYC official website, private Discord channels, and exclusive events (such as the only Bored Ape "treasure hunt" competition in September 2021 and the in-person "Ape Fest" celebration in November 2021) with the opportunity to hang out with each other. BAYC owners even have a voice in what the project's funds are used for, providing another avenue for them to feel like they are contributing to the direction of the community. Also worth noting is that, compared to the general crypto community at large, the community of Bored Ape (or any other NFT) holders is much smaller, which encourages quick changes and growth of an active ecosystem around the NFT. As the only way to participate in this ecosystem is by owning a Bored Ape, the value of the NFT is inherently tied to the value that people find in belonging to the community.

These unconventional aspects of NFT markets are made possible by the underlying blockchain infrastructure. By the decentralized nature of blockchain, NFTs significantly reduce the cost to verify the ownership of an asset, building "sturdy" community for NFT holders. Compared to traditional markets, NFTs also provide more liquidity without centralized intermediaries, which lowers the barrier to entering the market or transferring ownership. Further, blockchains provide standardized and public infrastructure layers that reduce the cost of interoperability and portability. With the prevalence of blockchain, people can simply point to their crypto wallets to publish the same content across multiple platforms.

While NFTs are a trendy topic in the crypto community, there is also a lot of doubt surrounding the viability of NFTs. Scott pointed out that a market for an asset cannot exist without a clear definition of ownership. That said, NFTs propose a new class of digital assets that serve as proof of ownership, so they may potentially result in new types of transactions and marketplaces, and ultimately intriguing new questions to explore in market and mechanism design.

Conclusion

The area of Web3, DeFi, and blockchain technology is evolving rapidly. Every day, entrepreneurs and practitioners are building on the theoretical insights from cutting-edge academic research to create innovative new technologies. At the same time, the field can often feel mysterious, even to experts – there is not yet much consensus in the community with respect to basic definitions and questions, not to mention approaches and solutions. Ongoing research is still trying to gain a comprehensive understanding of blockchain technology, and as such, this year's SIGecom Winter Meeting was largely expository and exploratory. The discussions,

both technical and non-technical, were highly clarifying and inspiring. For computer scientists and economists in the EC community starting to think about blockchain and Web3, the road ahead may be challenging – but this meeting highlighted the many exciting discoveries to be made, and the supportive community of like-minded researchers driving this thriving field.