Adding FinTech and Blockchain to Your Curriculum

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ABSTRACT

Institutions are at a watershed regarding the means that they use to provide financial and insurance services to enterprises and consumers. FinTech, technology solutions and startups that have disrupted and/or improved the way finance, banking and insurance industries do business, has become one of the largest growth industries in the worlds of finance and technology. Blockchain has gained great attention, investment, and development within FinTech because it addresses two of the riskiest aspects of life and business on the Internet: transactions and trust. There are exciting career and advancement opportunities for business and technology students, faculty, and universities to equip the next generation of FinTech architects and innovators. Recently, some universities have begun to develop programs, courses, and groups to support FinTech innovation and education. In this paper, we review FinTech and Blockchain. We conclude by reviewing some of the approaches used by universities to teach FinTech and Blockchain.

Keywords: FinTech, Blockchain, Bitcoin, transactional ownership and security, mining, data synchronization

INTRODUCTION

Today, we have come to a watershed in the means that institutions use to provide financial and insurance services to enterprises and consumers. While many of us are already familiar with Apple Pay or Samsung Pay, mobile payments solutions, we may have limited knowledge and experience with FinTech. FinTech, however, is much greater in its reach and impact on nearly all businesses, including even consumers and enterprises in emerging economies.

In this paper, we provide some general background on FinTech and one particular aspect of FinTech, Blockchain, significant topics to include in your curricula in finance, entrepreneurship, strategy, and other business subjects. After a general review of FinTech, we follow with more detailed discussion of Blockchain. We conclude with a summary of how universities differ in their approaches to teaching FinTech and Blockchain. Drawing from this summary, you may find a means to include FinTech and Blockchain within your own courses in a manner that is appropriate both for your curricula and for your university.

WHAT IS FINTECH?

FinTech, defined as technology solutions and startups that have disrupted and/or improved the way finance, banking and insurance industries do business, has become one of the largest growth industries in the worlds of finance and technology. The sector is becoming the next great technology revolution, like no other seen in the last ten years. The promise of today's FinTech includes greater security, faster transactions, and revolutionary options for commerce, financial services, and insurance.

The industry is likely to upend traditional banking, finance, and insurance with solutions that serve consumer and business needs in an ever changing, technology-driven culture. A new generation of technology entrepreneurs and finance sector veterans have dreamt up and built innovative financial solutions like Blockchain, crowdfunding, mobile payments, and peer-to-peer lending, taking a centuries old industry and standing it on its head.

FinTech: Description and History

Technology, strategy, and finance have been tightly interwoven for decades. One such union and a significant factor in consumer banking strategies for many financial institutions, the ATM (automated teller machine), first appeared in 1967. More recently, responding to the growth of the Internet and the shift toward mobile platforms, nearly all financial institutions and insurance companies have shifted their strategies and their commitments.

After the crash of the financial sector in 2008, a great confluence of events catapulted FinTech to new prominence as a new industry. During the recovery that followed, the financial sector was charged with implementing the Dodd-Frank Act, a massive set of new regulations meant to prevent any future crash, and 8.7 million people, many from the worlds of finance and banking, were newly unemployed. Along with disruption and regulation, however, this era saw the ubiquity and the utility of smartphones among consumers.

FinTech start-ups began to crop up to address pent up demand for mobile and online commerce apps, greater security, and small and micro business financing and services. This period saw the emergence of companies like Square for micro-mobile payments (founded 2009); Kickstarter, for crowdfunding (founded 2009); and SoFi, for online personal loans (founded 2011). Both Bitcoin and Blockchain also were born (founded 2008). Because of legacy technology and massive regulatory burdens, incumbent institutions could not move fast enough to keep up with these young upstarts, and a whole generation of newly invented financial, banking, and insurance solutions were created all over the world. The large institutions did not sit back and watch all of this happen, however. Instead, they bought start-ups, funded new innovations, and developed their own technologies. The battle between existing players and newcomers is ongoing.

For incumbent institutions, small businesses, and consumers alike, the capabilities of many of the latest FinTech innovations have justified the excitement and massive investment. New technology, like Blockchain or distributed ledger, promises virtually un-hackable transactions to create secure commerce and record-keeping like never before seen.

FinTech makes the 'gig economy' (a flexible, distributed, often self-employed model of working, think Uber) more possible than ever, providing easier, more available services to this sector of the workforce such as mobile payments and billing, micro-funding, and personalized insurance. Consumers have celebrated the convenience and ease by which payments can be made and received with technologies like Apple Pay and Google Wallet.

Perhaps one of the greatest impacts of FinTech will be on the 1.2 billion unbanked people around the globe. Revolutionary technologies will enable them to become part of the global economy, buying, selling, sending and receiving money, all with no physical bank involvement by simply using a mobile phone and cellular network.

FinTech generally comprises two categories, cooperative or disruptive. Cooperative FinTech works with the existing finance infrastructure and either streamlines it or makes it more user-friendly (e.g. online banking). Disruptive technologies have reimagined finance altogether and invented new ways of doing business (e.g. crowdfunding). The industry is also often segmented by the business process it provides (e.g. deposit accounts, payments, lending, wealth management or investing, insurance, markets, and back office operations) and the customer segment it serves (e.g. retail banking, insurance, and corporate banking).

Driving this revolution are the educated, experienced, and imaginative young entrepreneurs and finance industry greats, many displaced after the Great Financial Crisis of 2008. (bitcoinist.net) In this arena lies an incredible opportunity for business and technology students, faculty, and universities to equip the next generation of FinTech architects and innovators. Over the last two years, universities have recognized this fact and begun developing programs, courses, and groups to support FinTech innovation and education. This sector, if developed properly by universities, has the potential to offer exciting career and advancement opportunities for an entire generation of business and technology students. Both universities with business schools and students who fail to recognize the vast opportunity may be left behind.

A Well-Capitalized Industry

The private sector has certainly acknowledged the promise and the growing importance of FinTech by heavily investing in it through venture capital, private equity, direct corporate investments, and public offerings. In fact, investments have risen exponentially from $4.05 billion in 2013, to $12.21 billion in 2014, and $22.3 billion in 2015.

In addition to this plethora of financial resources, investment dollars, and venture capital, however, being funneled companies are channeling their foci and pouring vast amounts of other resources into the sector. For example, incumbent institutions such as JP Morgan Chase have an internal incubation lab to develop Blockchain technologies.

Also, a consortium comprising more than sixty financial institutions has formed and is targeting financial and human resources towards developing the next generation of Blockchain technology for the finance and banking sectors. The 225-year old State Street Bank recently launched a Blockchain R&D facility in Ireland, inviting university students to conduct research into new banking technologies. (Tapscott, 2016) Additionally, there are countless entrepreneurs and innumerable start-ups that are developing financial technology and solutions to disrupt the way business is done.

LOOKING AT BLOCKCHAIN

Blockchain has gained great attention, investment, and development within FinTech because it addresses two of the riskiest aspects of life and business on the Internet: transactions and trust. We've long recognized the security, privacy, and trust issues that plague the Internet, and since the early 1980s, technologists have been working on a solution to these problems. Until recently, the use of intermediaries was the best method to completing transactions securely and with trust. As we know, however, security is often a weak point, and data breaches leave individuals' personal and financial information vulnerable, thereby often putting trust at risk.

A solution came in 2008 when Satoshi Nakamoto (a pseudonym for an unknown person or group) published a paper outlining a protocol (a set of rules or procedures for transmitting data between electronic devices, such as computers) that created a peer-to-peer, electronic cash system using digital currency, now known as Bitcoin. Although some are skeptical of Bitcoin's success as a legitimate currency, the technology that underlies the digital currency has thrilled technologists, business leaders, and technology companies alike. This shift in interest, attention, and investment from Bitcoin the currency to the Blockchain technology that underlies it is recent, transpiring in 2014. In particular, financial institutions began to recognize its disruptive capabilities, and venture capital began to pour into the new sector of technology. (Swan, 2015)

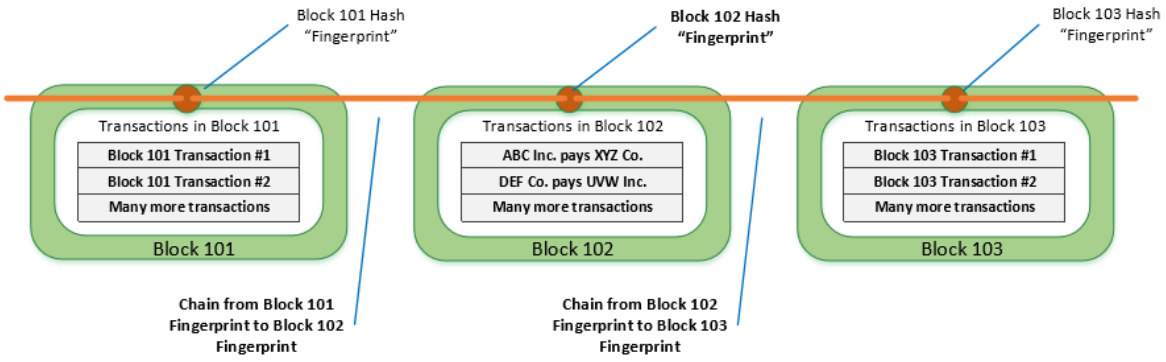
How It Works

Blockchain technology runs as a protocol or application atop the current stack of Internet protocols using the Internet as its mode of connection to its distributed network of nodes. This protocol, however, is built and designed specifically for the transfer of value and property, to make possible secure, transparent, immutable economic transactions; the original design for the Internet neither appreciated the need for nor offered this capability.

The Blockchain is built upon a distributed network, as opposed to a centralized or decentralized network. A distributed network is made up of numerous, equal peers or nodes, with connections forged among other peers on the network; each node runs a copy of the universal ledger, and they all synchronize regularly. So, as one might imagine, the network is very resilient from attack, and failure is unlikely. Even if one node is compromised, all the other peers or nodes maintain the integrity of the ledger.

The exhibit below shows an overview of how the blocks are built and chained together, including the data storage structure and the financial transactions themselves.

Figure 1: How Blockchains, Blocks, and Transactions Work



A Blockchain is composed of blocks chained together via a 64-hexadecimal character hash "fingerprint" assigned to each block, with blocks containing many individual transactions. Blockchain also uses public and private

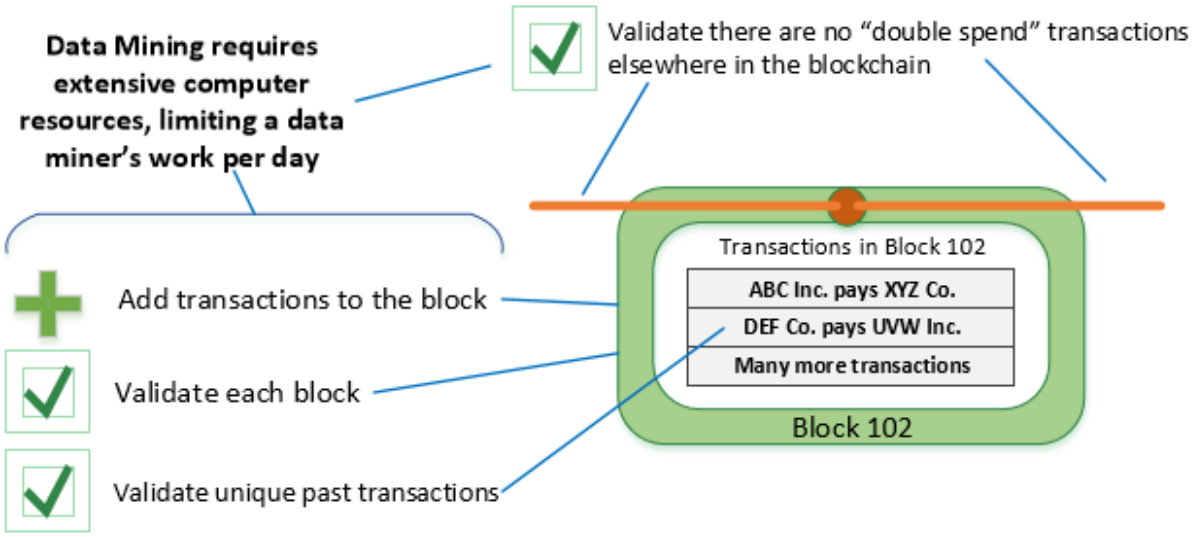
cryptographic keys to provide confidentiality and to establish authority. All data is encrypted with both a public key and a private key. Thus, in order to unlock data or a transaction, both keys must be present. One encrypts, the other decrypts and vice versa.

Put simply, the brilliance of Blockchain technology is in its structure as a single record of all transactions; thus, duplications or discrepancies among records do not exist. Before any transaction may be recorded in the Blockchain, the network must reach consensus; and each recorded transaction, moreover, is viewable to all yet immutable. Further, the Blockchain is distributed among countless nodes and encrypted in a well-nigh unbreakable code and structure.

Without being tracked by a third-party verification authority, digital cash, similar to other data on the Internet, was easily duplicated (a double-spending problem). Thus, one unit could be copied or counterfeited and then spent multiple times with no way to distinguish among the original or real unit of currency and a potential bevy of counterfeits. Blockchain combines the distributed network and the cryptography of the public keys to prevent the double-spending problem. A transaction's ownership is recorded in the Blockchain ledger, and all ensuing activities become part of its history, viewable to the entire network.

Transactional ownership and verification is accomplished via Blockchain mining. *Mining* is a Blockchain term for cryptographic data processing to enforce the system's integrity. Mining continually checks transactions that occurred previously, making sure the block's chronological sequence is correct and preventing the modification of blocks that contain valid past transactions. If an older block is modified, all subsequent transactions involving that block are invalid. Mining also prevents new invalid blocks from being added to the Blockchain, requiring considerable computing resources from each Blockchain node in the network. In effect, Blockchain mining comprises a digital vault through enormous numbers of computer-driven transactional checks; thus, thorough trust in the digital miner organization, the digital systems, and their personnel is crucial.

Figure 2: Mining Blockchains, Blocks, and Transactions
(McKinsey & Company, 2016)



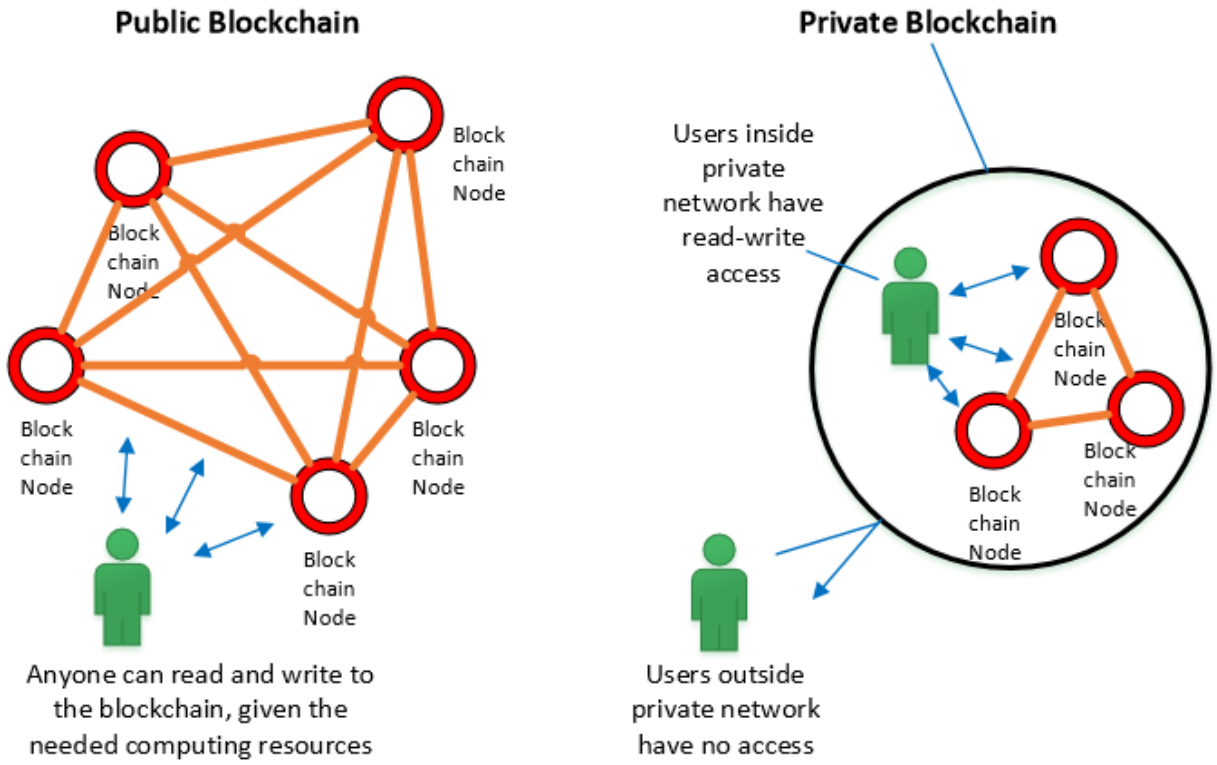
Blockchain application programming interfaces (APIs) are commonly utilized for mining through a variety of computer languages such as C++, Java, .NET (C#), Python, Ruby, PHP, Node, Javascript, Assembly, and others. The flexibility of APIs allows users to consider incorporating Blockchain financial technology as a component within a company's own applications.

Although the Blockchain was originally envisioned and designed to record the transactions of the cryptocurrency Bitcoin, in its future iterations, Blockchains will be used outside of financial transactions as a registry of any asset of value and as a system to record, to track, to transact, and to monitor. This usage will extend beyond economic value and property to even more intangible assets like a vote, one's reputation, or health data. (Norton, 2016)

There are two basic types of Blockchains: public and private. Public Blockchains allow anyone to write and to read data without permission from an authority, with the most notable example being Bitcoin. Anyone with a computer or smart device can download the Bitcoin software and create a personal digital wallet.

Private Blockchains have known participants who have controlled read and write access, working like a private network. A private Blockchain could be a group of related companies, an industry group, or a department within a company.

Figure 3: Public and Private Blockchains



Blockchains offer intriguing advantages. When using Blockchain in a financial transaction, there are no third parties, since the value flows from the initiator to the receiving party. The familiar financial middleman is replaced by a Blockchain technological system, with the potential to cut down on fraud and identity theft. In effect, Blockchains work like an electronic form of cash, with middlemen disintermediated. This has significant implications for financial services and insurance companies.

Blockchains replace paper in financial transactions, making money movement real-time fast. Blockchain mining does continuous financial audits multiple times per day, thus, avoiding the need for periodic financial audits. Since Blockchain data is viewable by others, it offers financial transparency. Blockchains also have an advantage of removing regulatory overhead and its costs, requiring buy-in from all financial stakeholders, including government.

Of course Blockchains' cash-like nature has spawned illicit use, so anyone contemplating using Blockchains should exercise caution when doing so. In 2014, Mt. Gox, the largest Bitcoin exchange at the time, was hacked, causing more than $300M of loss to its users. Bitcoin, too, has been used for nefarious purposes; it was the currency of choice for online black market purchases of illegal drugs on the darknet platform the Silk Road until 2013, when the FBI arrested its owner and shut it down.

The lack of Blockchain regulation could alternatively work to its disadvantage. For example, Blockchains are diametrically opposed to current banking business practices. As a currency disconnected from regulation, the digital

currency worth could be volatile as has been seen with Bitcoin.

Another disadvantage of Blockchain is that miners within its organization nodes must acquire substantial computer hardware and software to do continuous financial transaction checks, requiring both specialized organization and people skill sets.

Security Needs
As noted above, cryptography and digital signatures provide identity and valid user access to data, so ensuring security must be uppermost in the minds of Blockchain implementations.

Blockchains depend on distributed servers housing a replica of all Blockchain data; thus, data synchronization is essential to ensure the full data set appears in all servers. In our experience, replication synchronization can be problematic, so there should be safeguards in place to ensure all servers are current. Before moving to private Blockchains with trusted users, companies must ascertain that the Blockchain data architecture is a good fit.

How Blockchain is Being Used Today
Because of its capabilities in security, in privacy, and in data management, Blockchain has captured the interest and the resources of the financial industry as well as the attention of numerous other major industries from music to healthcare to even governments around the globe. Currently Blockchain is being tested by financial institutions to increase security, to provide transparency, and to speed transactions; manufacturers also use it as a digital means to track supply chains and to enforce contracts. Finally, governments employ it to verify and to secure property records and records of citizenship. Some even use it for tax filing and voting. On the Blockchain, the individual will control access to her personal data, much like she decides how her money is used. With both personal funds and personal data, she is able to disburse them when, where, and with whom she pleases.

The Bitcoin Blockchain is the largest, most well-known, and public Blockchain currently in use. There are numerous companies and industries exploring applications and uses of this Blockchain. However, there is also a great deal of interest, development, and testing going on with private Blockchain networks that have a limited and permissioned set of participants. (Wong) The financial industry, set to be Blockchain first-movers, has already invested heavily in exploring and developing technologies on Blockchain. *The Wall St. Journal* reported that as of early 2016, large banking institutions and financial markets have invested over $1 billion in the industry. Ninety-one percent of all investment in Blockchain/Bitcoin startups has occurred since 2014, with 60 percent transpiring since 2015. Start-ups and legacy corporations alike (*e.g.* IBM) are building pilots to test settlement of trades, clearing transactions, and verification of trades and transactions dealing with stocks, loans, derivatives and various assets.

WHAT UNIVERSITIES ARE DOING

Universities seem to be approaching FinTech and Blockchain in different ways, including adding courses, degree programs, lecture series, and boot camps; forming student clubs; and, even, incubating entrepreneurial ventures. Many leading universities have started adding FinTech to their coursework in one way or another. Some programs focus more on the technology side, for example, by teaching about the technical aspects of Bitcoin, Blockchain, and cryptocurrencies. Some programs are focusing on data analytics, a critical benefit of robust FinTech.

Other programs explore the sector at a higher level, offering a study of all the different ways FinTech is disrupting the financial, banking, and insurance sectors and encouraging entrepreneurial business development. Simon Fraser University in British Columbia, for example, has even gone so far as to start accepting Bitcoins as payment in its bookstores and even installed BTMs (Bitcoin Teller Machines) around campus to provide students with a literal hands-on cryptocurrency-learning environment. The university has also formed its own Bitcoin Club to help students dive further into the world of FinTech and digital currency. Indeed, the industry is broad enough that one could argue for the establishment of multiple degrees or, even, for a department to be built around the sector. For now, though, most universities are just beginning to explore and develop the study of FinTech.

We have found that universities are approaching the teaching of FinTech and Blockchain in different ways. Here are some of our major findings:

- **Overview vs. specialized** – The split between courses that provide a broad overview of the entire FinTech universe *versus* courses that examine one specialized aspect of FinTech *(i.e.*, Bitcoin or cryptocurrency) is 50-50.

- **Courses and clubs** – One-third of universities that offer FinTech courses also have student-led FinTech groups. These groups enable students to supplement their studies by hosting events, attending conferences, writing papers, performing internships, and engaging in career networking.
- **Master's degree programs** – Only two of the universities in our study offer FinTech graduate degree programs.
- **Course materials** – Of the programs examined, most use business cases, research articles, and white papers as teaching material to supplement course lectures and projects. There is one course that uses a textbook *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction* by Narayanan, Bonneau, Felten, Miller and Goldfeder.
- **Instructors** – The majority of courses and programs have lecture-based courses taught by an instructor and supplemented with numerous guest lecturers. The guest lecturers are generally FinTech executives and entrepreneurs as well as FinTech investors from venture capital and private equity firms.
- **Emphasis** – As shown in the chart below, the top three emphases among courses in the programs examined included entrepreneurship, finance, and cryptocurrency.

At Northeastern University, we have begun the effort to incorporate FinTech and Blockchain into our business school curriculum. More specifically, we introduced material related to FinTech and Blockchain in some courses in finance, strategy, entrepreneurship, and information technology. Drawing on the experience of several alumni who are working in the field, we hosted a symposium for students. Like many universities, we are forming a FinTech club for our students. We also plan to have some of our undergraduate and graduate students work at FinTech companies for their coop employment. We welcome your inquiries regarding our efforts and would be delighted to share ideas on what is working for us.

CONCLUSIONS

FinTech has become one of the fastest growth industries in the worlds of finance and technology. Blockchain, within FinTech, may have significant far beyond financial services and insurance. FinTech will be evolutionary, not revolutionary. FinTech curriculum if developed properly by universities has the potential to offer exciting career and advancement opportunities for an entire generation of business and technology students.

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