Blockchain and cryptocurrencies

1. Preliminary concepts at the basis of Blockchain [2],[3]
   1.1. Introduction to the cryptography concepts used in Blockchain [3]
      - Cryptography services (confidentiality, authentication, integrity, non-repudiation)
      - Public and private key cryptography
      - Elliptic curve cryptography
      - Hash functions
      - Elliptic curve digital signature algorithm (ECDSA)

   1.2. Distributed systems and decentralization

   1.3. Consensus & Byzantine generals problem

2. Introduction to Blockchain [2],[3]

   2.1. What is a Blockchain

   2.2. Blockchain features

   2.3. Types of Blockchain (public, consortium, private)

   2.4. Blockchain history (why it was invented)

   2.5. Overview of today Blockchain applications

3. Bitcoin [7],[1]

   3.1. Bitcoin protocol specification
      - Overview of Bitcoin data types (transaction, scripts, adresses, blocks)
      - Transactions
      - Bitcoin network architecture
      - Bitcoin blockchain (blocks structure, Merkle trees, mining, proof of work)

3.2. Bitcoin wallets

4. Bitcoin privacy
    - Considerations on user anonymity in Bitcoin
    - Possible attacks
    - How to enhance privacy in Bitcoin (explanation of mixing services + reference [6])
5. Bitcoin blockchain scalability
    - Considerations on the scalability of the Bitcoin blockchain and possibile solutions [7],[5]
6. Alternatives to Bitcoin
    - Bitcoin limitations
    - Alternatives to proof of work [4]
    - Namecoinsd
    - Litecoin
    - ZCash
7. Smart contracts
    - History
    - What smart contracts are
    - Security
8. Ethereum
    - History
    - Ethereum components (Keys, addresses, accounts)
    - Ethereum blockchain
    - Ethereum network
    - Ethereum transactions
    - Ethereum virtual machine
9. (Possibly) Pratical example of blockchain application: development of a distributed application through Ethereum Solidity (Something similar to the application development shown in reference [2])

References

[1] A.M. Antonopoulos. *Mastering Bitcoin: Programming the Open Blockchain*. O'Reilly Media, 2017. ISBN: 9781491954362. Available at: https://books.google.it/books?id=MpwnDwAAQBAJ.

[2] J.J. Bambara et al. *Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions*. McGraw-Hill Education, 2018. ISBN: 9781260115864. Available at: https://books.google.it/books?id=z5hIDwAAQBAJ.

[3] I. Bashir. *Mastering Blockchain*. Packt Publishing, 2017. ISBN: 9781787125445. Available at: https://books.google.it/books?id=dMJbMQAACAAJ.

[4] Iddo Bentov, Ariel Gabizon, and Alex Mizrahi. "Cryptocurrencies Without Proof of Work". In: *Financial Cryptography and Data Security*. Ed. by Jeremy Clark et al. Berlin, Heidelberg: Springer Berlin Heidelberg, 2016, pp. 142–157. ISBN: 978-3-662-53357-4.

[5] Kyle Croman et al. "On Scaling Decentralized Blockchains". In: *Financial Cryptography and Data Security*. Ed. by Jeremy Clark et al. Berlin, Heidelberg: Springer Berlin Heidelberg, 2016, pp. 106–125. ISBN: 978-3-662-53357-4.

[6] Ethan Heilman, Foteini Baldimtsi, and Sharon Goldberg. "Blindly Signed Contracts: Anonymous On-Blockchain and Off-Blockchain Bitcoin Transactions". In: *Financial Cryptography and Data Security*. Ed. by Jeremy Clark et al. Berlin, Heidelberg: Springer Berlin Heidelberg, 2016, pp. 43–60. ISBN: 978-3-662-53357-4.

[7] G. Karame and E. Androulaki. *Bitcoin and Blockchain Security*. Artech House information security and privacy series. Artech House, 2016. ISBN: 9781630810139. Available at: https://books.google.it/books?id=b%5C_nwjwEACAAJ.