Course Schedule

BLOCKASTICS: Stochastic models for blockchain analysis

Pierre-O Goffard

Week 1: Blockchain concepts and application

- What is a blockchain?
- Consensus Protocol
- Security, Decentralization and Efficiency
- Application: Cryptocurrency and Decentralized Finance

Week 2: Double spending with random walks

- What is a Double Spending Attack?
- Nakamoto's Random Walk Model
- Double Spending Probability
- Double Spending Time Distribution

Week 3: Double spending with Poisson processes

- Double Spending in Continuous Time with Counting Processes
- Exponential distributrion and Poisson processes
- Exponential Martingale
- Double Spending Probability
- Apell and A-G polynomials

Week 4: Decentralization in PoS

- Proof-of-Stake
- Polya's urn model
- The average stake own by the blockchain peers
- Asymptotic distribution of stakes accross the blockchain peers network

Week 5: Decentralization in PoW

- Mining pools and reward distribution systems

- Pay-per-Share and blockchain miners risk management
- Risk of centralization

Week 6: Blockchain Efficiency

- Blockchain queeing model
- Distribution of the queue length
- Estimating Throughputs and Latency

Week 7: Bitcoins returns and Hidden Markov models

- Hidden Markov models
- Bayesian estimation of HMM
- Application on the bitcoin prices (rather the bitcoin log-returns)

Week 8: Blockchain Workshop

- Schedule TBD