

# Building Blockchain Apps

# **Building Blockchain Apps**

# **Table of Contents**

Cover

Title Page

Copyright Page

Contents

**Foreword** 

Acknowledgments

About the Author

Part I: Introduction

1 An Introduction to Blockchain

The Blockchain

The Collaborative Ledger

Cryptocurrency

**Smart Contracts** 

A Trustless Network

New Ways of Collaborating

The Fat Protocol

In Code We Trust

Conclusion

## 2 Reaching Consensus

What Is Blockchain Consensus?

Proof of Work (PoW)

Proof of Stake (PoS)

Delegated Proof of Stake (DPoS)



#### Conclusion

## 3 Your First Blockchain App

**Smart Contract** 

Front-End HTML

JavaScript and web3.js

In Action

Share Your Dapp

Conclusion

## Part II: An Introduction to Ethereum

## 4 Getting Started

The BUIDL Way

**Ethereum Mainnet** 

**Ethereum Classic Mainnet** 

CyberMiles Mainnet

## The Hard Way

Metamask Wallet

Remix

Web3

Conclusion

## 5 Concepts and Tools

Ethereum Wallet and Basic Concepts

Etherscan

The TestRPC

Interacting with Ethereum via GETH

Interacting with Ethereum via web3

Running an Ethereum Node

Running a Private Ethereum Network

Conclusion

#### 6 Smart Contracts

Hello, World! Again



## **Learning Smart Contract Programming**

Consensus vs. Nonconsensus Code

**Data Structures** 

Function Parameters and Return Values

Payable Functions

Calling Other Contracts

#### Building and Deploying the Smart Contract

Solidity Tools

The BUIDL Integrated Development Environment (IDE)

The Remix IDE

Truffle Framework

## Calling Smart Contract Functions

The BUIDL IDE

The Remix IDF

**GETH Console** 

## A New Language

More Smart Contract Languages

Conclusion

## 7 Decentralized Applications (Dapps)

## Dapp Stack

The web3 Library

**External Services** 

## Dapp Showcases

Uniswap

CryptoKitties

**Gambling Games** 

Interactive Dapps

Conclusion

## 8 Alternatives to Dapps

#### **JavaScript**

The Full-Node Wallet

**Raw Transactions** 



Python and Others

Conclusion

## Part III: Ethereum in Depth

#### 9 Inside Ethereum

What Is Blockchain State?

Ethereum State

Data Structure

Trie (or Tree)

Standard Trie

Patricia Trie

Similarities between the Trie and Patricia Trie

Main Difference between the Trie and Patricia Trie

Modified Merkle Patricia Trie

#### Trie Structure in Ethereum

State Trie: The One and Only

Storage Trie: Where the Contract Data Lives

Transaction Trie: One per Block

Concrete Examples of Tries in Ethereum

#### Analyzing the Ethereum Database

Get the Data

Decoding the Data

Read and Write the State LevelDB

Conclusion

## 10 Blockchain Data Services

Blockchain Explorers

Harvesting Data

Transactions and Accounts

Awards

Off-Chain Identities

Inside Smart Contracts

Query Interface



SQL Query
JSON Query
GraphQL
Google BigQuery

Whats Next?

Conclusion

## 11 Smart Contract Search Engine

Introduction to the Smart Contract Search Engine

Getting Started with a Smart Contract Search Engine

#### The FairPlay Dapp Example

A Modular Architecture

Using the Smart Contract Search Engine

#### **Use Cases**

Crypto Assets

DeFi

Gaming

Conclusion

## 12 Smart Contract Security and Best Practices

#### Major Ethereum Smart Contract Hacks and Vulnerabilities

Decentralized Autonomous Organization Hack

**BEC Token Hack** 

The Parity Wallet Hack

FOMO3D and LastWinner Dapp Hack

Unknowns and Beyond

## Best Practices for Securing Smart Contracts

**Expert Manual Auditing** 

Formal Verification

Sandbox

Tools

Conclusion

## 13 The Future of Ethereum



#### Ethereum 1.0

Privacy

Consensus

Scalability

Token Improvements

#### Beyond Ethereum 1.0

Sharding

Zero-Knowledge Proofs

#### Ethereum 2.0

The Beacon Chain

eWASM

## Delivery Phases of Ethereum 2.0

Phase 0

Phase 1

Phase 2

PostEthereum 2.0 Innovation

Conclusion

# Part IV: Building Application Protocols

## 14 Extending the Ethereum Protocol

Fully Compatible, Yet Faster

Smart Enhancements to the EVM

**Trusted Oracles** 

Secure Random Numbers

Alternative Gas Fees

Safety First

Conclusion

## 15 Extending Ethereum Tools

#### **Smart Contract Tools**

Venus Wallet

Europa IDE

The lityc Compiler and Analysis Tool



## Dapp Tools

web3-cmt

CyberMiles App

Conclusion

## 16 Example Dapps

Case Study 1: Valentines

The Valentines Smart Contract

The JavaScript Dapp

Case Study 2: WeBet

WeBet Smart Contract

WeBet JavaScript Application

Dapp Off-Chain Operations

Conclusion

## 17 Business Rules and Contracts

An Example

## Rules Language

Rete Algorithm

Rule Attribute

Rule Filters

Rule Actions

Rule Inheritance

Working Memory

## More Business Examples

Insurance Claim

Taxes

**Product Combos** 

Conclusion

# 18 Building an Application-Specific EVM

Using libENI Functions

The String Reversing Example

The RSA Example



The Scrypt Example

#### Writing a libENI Function

Parsing Arguments

**Estimating Gas** 

**Executing the Function** 

Mapping to libENI Function Name

#### Deploying the libENI Function

CyberMiles Governance

Conclusion

# Part V: Building Your Own Blockchain

## 19 Getting Started with Tendermint

How It Works

It Works as Follows

Set Up a Node

Set Up a Network

Conclusion

## 20 The Business Logic

The Protocol

Consensus on the Block

Consensus on the Transactions

Getting Information

A Sample Application

Java Implementation

GO Implementation

The Cosmos SDK

Conclusion

## 21 Creating a Blockchain Client

Overview of the Approach

The Sample Application

PHP



Java

Conclusion

## Part VI: Cryptoeconomics

## 22 The Cryptoeconomics of Token Design

## **Network Utility Tokens**

Bitcoin (BTC)

Ethereum (ETH)

ZCash (ZEC)

## **Application Utility Tokens**

#### Security Tokens

The DAO

Token Funds

#### **Token Valuation**

**Utility Tokens** 

**Design Considerations** 

An Alternative Approach

#### **Advanced Topics**

Nonmonetary Pricing

Stable Coins

Conclusion

## 23 Initial Coin Offerings

## A Brief History

## Utility of an ICO

Facilitation of the Blockchain Project

Fundraising

## ICO vs. Traditional Equity Financing

Entry Barrier to Investment

Entry Barrier to Fundraising

Regulation/Paperwork

Liquidity after Fundraiser

Community Participation



Risk

Market Size

## Evaluating an ICO Project

Project

Team

Fundraising Structure

Token Distribution Table

Community

Legal Framework

#### ICO Participation Risk

Hacking Risk

Project Development Risk

Team Risk

Conclusion

## 24 Cryptocurrency Exchanges

## **Exchange Types**

Fiat Currency Exchanges

Tokens-Only Exchanges

Security Token Exchanges

Decentralization

Products and Services

Conclusion

# A: Getting Started with CyberMiles

Index

