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TIC

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LECCIÓN 2

Optimization and Security in Smart Contracts.

TALENTO TECH

AZ | PROYECTOS EDUCATIVOS

Universidad Tecnológica de Pereira

7.Before the reading activity, explain the inference reading comprehension.

Inference reading comprehension involves drawing logical conclusions or making educated guesses based on information provided in a text, even when the information is not explicitly stated. It requires readers to use their background knowledge, contextual clues, and reasoning skills to infer meanings, relationships, or details that may be implied rather than directly expressed in the text.

This reading comprehension skill goes beyond understanding the literal meaning of the words and sentences. Instead, it involves making connections between what is stated explicitly and what can be logically inferred from the information presented. Inferences often require readers to consider the author's intentions, the context of the text, and the relationships between different pieces of information

Effective inference reading comprehension allows readers to grasp the deeper meaning of a text, fill in gaps in information, and understand the implications of what is being communicated. It is a critical skill for comprehending complex texts, making predictions, and engaging with written material in a more nuanced and insightful manner.

8. Socialize key words about "Smart Contracts Redefined: Innovations in Blockchain Technology"

1. Smart Contracts: Self-executing contracts with terms directly written into code, operating autonomously on blockchain networks.

2. Decentralized Autonomous Organizations (DAOs): Organizations governed by code, enabling decentralized decision-making and resource allocation through smart contracts.

3. Interoperability: The capability of smart contracts to operate seamlessly across different blockchain networks, enhancing collaboration and connectivity.

5. Programmable Money: The concept within smart contracts where regulations dictating the flow and utilization of funds are integrated directly into the contract code.

7. Use Cases in Finance: Application of smart contracts in decentralized finance (DeFi), automating financial services like lending, borrowing, and trading.

9. Real Estate and Property Transactions: Streamlining and securing property transactions through smart contracts, automating the transfer of ownership with predefined conditions.

4. Blockchain: A decentralized and distributed ledger technology that underpins cryptocurrencies, ensuring transparency and immutability in transactions.

6. Security Considerations: Critical aspects ensuring the secure functioning of smart contracts, involving robust code, secure infrastructure, and regular audits.

8. Supply Chain Management: Utilization of smart contracts to enhance transparency and traceability in supply chains by automating and validating transactions.

10. Scalability Issues: Challenges faced by smart contracts in managing a substantial volume of transactions concurrently, with ongoing exploration for solutions like layer 2 scaling strategies.

9. Reading comprehension #2: "Smart Contracts Redefined: Innovations in Blockchain Technology"

Smart Contracts Redefined: Innovations in Blockchain Technology

Introduction

Smart contracts represent a groundbreaking advancement in the realm of blockchain technology, revolutionizing the way agreements are executed in a secure, transparent, and decentralized manner. At their core, smart contracts are self-executing contracts with the terms of the agreement directly written into code. This eliminates the need for intermediaries, such as banks or legal entities, streamlining processes and reducing the risk of fraud.

Smart Contracts Redefined: Innovations in Blockchain Technology

Overview of Smart Contracts

ISmart contracts operate on the principles of autonomy, efficiency, and trust. They automatically enforce and execute the terms of an agreement when predefined conditions are met, ensuring a tamper-proof and reliable execution of transactions.

Utilizing blockchain’s distributed ledger technology, smart contract development services are stored across a network of nodes, enhancing transparency and minimizing the risk of manipulation. This autonomy and transparency make smart contracts particularly well-suited for a myriad of applications, from financial transactions to supply chain management.

Evolution of Smart Contracts in Blockchain

The evolution of smart contract development services can be traced back to the inception of blockchain technology with Bitcoin. However, it was the introduction of Ethereum in 2015 that truly propelled the development and widespread adoption of smart contract development services.

Ethereum's blockchain development services provide a programmable platform, allowing developers to create decentralized applications (DApps) and smart contracts using its native scripting language, Solidity.

Since then, various blockchain platforms have emerged, each enhancing the capabilities and features of smart contracts, contributing to their evolution, and expanding their potential applications beyond simple financial transactions. As technology continues to mature, Smart Contract Development Company are poised to play a pivotal role in reshaping traditional business processes across diverse industries.

Foundations of Smart Contracts

What Are Smart Contracts?

Smart contracts function as automated programs within blockchain networks, eradicating the need for intermediaries by autonomously executing pre-established terms and conditions. Composed in computer languages, frequently employing languages such as Solidity for Ethereum, these programs reside on decentralized and distributed ledgers.

The primary objective of a smart contract is to optimize, authenticate, or enforce the negotiation and fulfillment of a contract, ultimately elevating efficiency, transparency, and trustworthiness across diverse processes.

How Smart Contracts Work

Smart contracts function based on conditional logic, operating on the principle of “if-then” statements. When specific predefined conditions are satisfied, the contract automatically initiates the designated actions.

This automated process is facilitated by the decentralized structure of blockchain development services, where the contract code is dispersed across numerous nodes, ensuring both transparency and security.

External events or transactions that meet the criteria set by the contract trigger the execution of Smart Contract Development Company, with the outcomes recorded on the blockchain development for verification by all participants.

Benefits and Challenges

The adoption of smart contracts comes with a range of benefits. Automation reduces the need for intermediaries, cutting costs and expediting processes. The decentralized and transparent nature of blockchain ensures security and trust, as all participants can independently verify the contract’s execution. Additionally, Smart Contract Development Company are highly versatile, finding applications in various industries beyond finance, such as supply chain management and legal agreements.

Blockchain Technology Overview

Basics of Blockchain

Blockchain development services is a decentralized and distributed ledger technology that underpins various cryptocurrencies and has found extensive applications beyond digital currencies. At its core, a blockchain consists of a chain of blocks, each containing a list of transactions. These blocks are linked together using cryptographic hashes, forming a secure and tamper-resistant chain. The decentralized nature of blockchain development company means that copies of the entire ledger are maintained across a network of nodes, ensuring transparency and immutability.

Role of Blockchain in Smart Contracts

Blockchain assumes a crucial role in enabling and elevating the capabilities of smart contract development company India. The decentralized and transparent characteristics inherent in blockchain establish a secure foundation for executing smart contract development company India.

Through a distributed ledger system, the terms and conditions of smart contracts are documented and authenticated by numerous participants, mitigating the potential risks associated with fraud or manipulation. Moreover, integrating blockchain into smart contracts instills a heightened sense of trust and efficiency, given that contract execution becomes automated and verifiable by all pertinent parties involved in the process.

Popular Blockchain Platforms

Numerous blockchain platforms have surfaced, each distinguished by its unique features and applications. Ethereum, a trailblazer in supporting smart contract development company India, serves as a decentralized arena for developers to construct and launch decentralized applications (DApps).

Alternatives like Binance Smart Chain, Polkadot, and Cardano present diverse options, featuring distinct consensus mechanisms, scalability solutions, and interoperability features. These platforms contribute significantly to the expanding ecosystem of blockchain technology, meeting a spectrum of needs across various industries, encompassing finance, supply chain, healthcare, and beyond.

As the landscape of blockchain technology undergoes continuous evolution, these platforms are poised to play a pivotal role in shaping the trajectory of decentralized applications and smart contract development company India.

Building Tomorrow: Exploring Blockchain Development Platforms

Introduction Brief overview of the role of blockchain development platforms Blockchain development platforms play a...
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Innovations in Smart Contracts

Self-executing Contracts

One of the primary innovations in smart contract development lies in its self-executing nature. These contracts are designed to automatically enforce the terms and conditions encoded within their code. When predefined conditions are met, the contract executes the specified actions without the need for intermediaries or manual intervention.

This automation not only streamlines processes but also enhances the efficiency and reliability of contract execution. Self-executing contracts reduce the risk of errors and fraud, providing a secure and tamper-resistant way to facilitate various transactions and agreements.

Programmable Money

smart contract development introduce the concept of programmable currency, wherein the regulations dictating the flow and utilization of funds are integrated directly into the contract code. This innovation heralds a heightened degree of financial automation and adaptability.

For instance, smart contract development can automate payment distribution, enforce regulations for crowdfunding initiatives, or facilitate intricate financial agreements, all without relying on conventional intermediaries. Programmable money expands the horizons, enabling the creation of dynamic and customizable financial instruments that can adjust to specific conditions and criteria.

Decentralized Autonomous Organizations (DAOs)

IDecentralized Autonomous Organizations (DAOs) represent a groundbreaking innovation facilitated by smart contract development. DAOs are organizations governed by code, where the rules for decision-making and resource allocation are encoded in smart contracts.

Participants in a DAO have voting rights proportional to their contributions, and decisions are executed automatically based on the consensus reached through smart contract development. DAOs provide a decentralized and transparent framework for collaborative decision-making, funding allocation, and project governance, eliminating the need for centralized authorities.

Interoperability and Cross-Chain Contracts

Interoperability has become a key focus in the evolution of smart contract development. Innovations in this area involve enabling smart contracts to operate seamlessly across different blockchain networks. Cross-chain contracts, facilitated by protocols like Polkadot and Cosmos, allow smart contracts to interact with assets and data on disparate blockchains.

This advancement opens the door to a more interconnected and collaborative blockchain ecosystem. Interoperability not only enhances the flexibility of smart contracts but also promotes a more inclusive and interconnected blockchain landscape, where assets and information can flow seamlessly across different blockchain networks.

Security and Trust in Smart Contracts

Security Considerations

Security is paramount in the realm of smart contracts, given their automated and irreversible nature. Several factors contribute to the security of smart contracts. The programming code must be robust and free from vulnerabilities to prevent potential exploits. Additionally, the infrastructure supporting the smart contract, including the underlying blockchain network, must be secure. Ensuring secure key management, employing secure development practices, and regularly auditing the smart contract's code are crucial aspects of enhancing security.

Common Smart Contract Vulnerabilities

Despite their potential, smart contract development is susceptible to various vulnerabilities. Common issues include reentrancy attacks, where an external contract manipulates the flow of execution, and arithmetic overflow/underflow, leading to unintended consequences. Inadequate input validation and insecure random number generation are other vulnerabilities that can be exploited. Smart contract developers must be vigilant in addressing these issues during the coding phase and conduct thorough testing to identify and rectify vulnerabilities before deployment.

Trustless Execution and Auditing

Trustless execution is a key feature of blockchain smart contract development meaning that participants can engage in transactions without relying on trust in a centralized authority. The transparent and decentralized nature of blockchain ensures that the execution of smart contracts is open to scrutiny by all participants, fostering trust in the system. However, achieving true trustlessness requires careful consideration of security measures and regular audits.

Use Cases and Applications

Smart Contracts in Finance

Blockchain smart contract development has found extensive applications in the financial sector, revolutionizing traditional processes. In decentralized finance (DeFi), smart contracts automate various financial services, including lending, borrowing, and trading. For example, decentralized lending platforms utilize smart contracts to facilitate peer-to-peer lending without the need for intermediaries like banks.

Smart contracts also enable the creation of financial instruments such as decentralized autonomous organizations (DAOs), which manage funds and make decisions through programmable rules encoded in blockchain smart contract development. This not only enhances efficiency but also reduces the costs associated with traditional financial transactions.

Supply Chain Management

Supply chain management is another domain where smart contracts are making a significant impact. Smart contracts enhance transparency and traceability in supply chains by automating and validating transactions at each stage.

For instance, smart contracts can automatically trigger payments when goods are delivered, ensuring that payment is made only after fulfilling predefined conditions. This reduces the risk of fraud, minimizes delays, and establishes a more reliable and efficient supply chain.

Real Estate and Property Transactions

In the real estate industry, smart contracts streamline and secure property transactions. Blockchain smart contract development can automate the transfer of property ownership, ensuring that all conditions (such as payment and verification) are met before the transfer is executed.

This reduces the need for intermediaries like title companies and expedites the often complex process of buying and selling real estate. The transparency and immutability of blockchain ensure a trustworthy and auditable record of property transactions.

Healthcare and Identity Management

Smart contracts play a crucial role in healthcare, particularly in the management of patient data and identity. Patient records stored on a blockchain can be accessed securely through blockchain smart contract development, ensuring data integrity and privacy.

Access to medical records can be granted or revoked based on predefined conditions, giving patients greater control over their health information. Moreover, smart contracts in identity management can streamline processes such as identity verification for healthcare services, making them more efficient and secure.

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Challenges and Future Directions

Scalability Issues

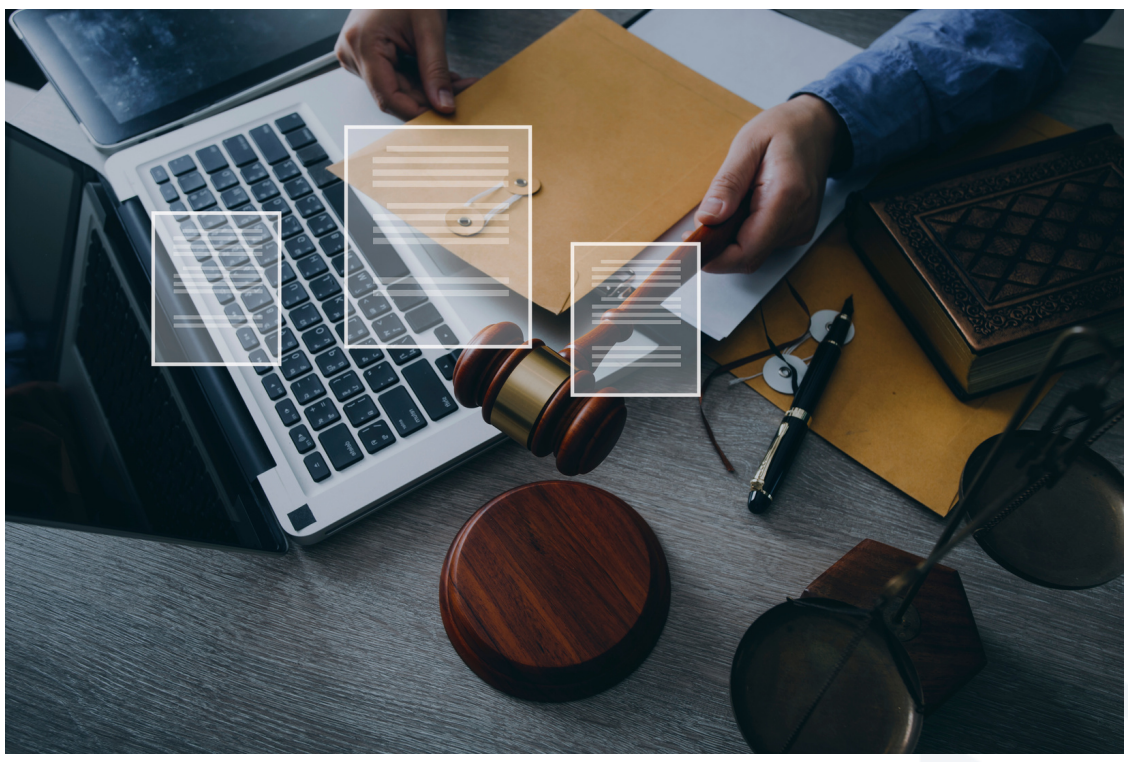
The extensive adoption of smart contract company faces a notable hurdle in the form of scalability. As blockchain networks expand, the ability to manage a substantial volume of transactions concurrently becomes imperative. Existing scalability constraints may lead to delayed transaction processing times and increased fees.

To mitigate these challenges and bolster the efficiency of smart contract platforms, ongoing exploration is focused on potential solutions, including layer 2 scaling strategies and advancements in consensus mechanisms. These endeavors aim to overcome scalability issues, ensuring a more seamless and cost-effective operation of smart contract platforms as they evolve.

Legal and Regulatory Challenges

The legal and regulatory landscape surrounding smart contracts is still evolving, presenting challenges to their broader acceptance. Questions regarding the enforceability of smart contracts in traditional legal systems and the jurisdictional aspects of blockchain transactions are areas that need clarity.

Regulatory frameworks need to adapt to accommodate the unique characteristics of smart contracts while providing legal certainty and consumer protection. Collaborative efforts between the technology sector and regulatory bodies are essential to establish a balanced and supportive legal framework.



Future Developments in Smart Contracts

The future of smart contract company holds exciting possibilities. Interoperability between different blockchain networks is likely to improve, allowing for seamless communication between smart contracts on various platforms.

Advances in privacy features, such as zero-knowledge proofs, may enhance the confidentiality of smart contract transactions without compromising transparency. Additionally, improvements in user interfaces and developer tools will contribute to a more user-friendly experience, encouraging broader adoption.

Mastering the Code: A Deep Dive into Blockchain Smart Contracts
Dive deep into the world of Blockchain Smart Contracts. Learn the ropes, make them work for you. A comprehensive guide…
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Case Studies

Ethereum and the Rise of Smart Contracts

The legal and regulatory landscape surrounding smart contracts is still evolving, presenting challenges to their broader acceptance. Questions regarding the enforceability of smart contracts in traditional legal systems and the jurisdictional aspects of blockchain transactions are areas that need clarity.

Regulatory frameworks need to adapt to accommodate the unique characteristics of smart contracts while providing legal certainty and consumer protection. Collaborative efforts between the technology sector and regulatory bodies are essential to establish a balanced and supportive legal framework.

Read Also

Creating Your Own DApp with Ethereum Smart Contract Development: A Step-by-Step Guide!

Binance Smart Chain: A New Approach

Binance Smart Chain (BSC) emerged as a new player in the blockchain space, offering an alternative approach to smart contracts. Launched by the cryptocurrency exchange Binance, BSC prioritizes high performance and low transaction fees. Its compatibility with the Ethereum Virtual Machine (EVM) allows developers to easily port Ethereum-based applications to BSC, fostering interoperability.

BSC's rapid rise underscores the diverse strategies employed in the blockchain ecosystem and the ongoing evolution of smart contract platforms. The case of Binance Smart Chain highlights the industry's responsiveness to addressing scalability and cost concerns, providing users with alternative platforms for smart contract execution.

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Implementing Smart Contracts

Smart Contract Development Tools

Smart contract development involves a set of tools tailored to streamline the creation process. Developers commonly utilize integrated development environments (IDEs) such as Remix and Truffle. Remix, a web-based IDE, simplifies smart contract development by offering features like real-time code compilation and debugging.

Truffle, on the other hand, provides a development framework with built-in testing and deployment functionalities. These tools empower developers to efficiently code, test, and deploy smart contracts by offering a conducive environment and essential utilities.

Coding Smart Contracts

The coding of smart contracts is typically done using specific programming languages supported by blockchain platforms. For instance, Solidity is the language predominantly used for Ethereum smart contracts. Developers define the contract's logic and conditions within the code, specifying how the contract should be executed under different circumstances.

Proper coding practices are crucial to avoiding vulnerabilities and ensuring the secure functioning of smart contracts. Developers need to consider factors like input validation, gas optimization, and adherence to best practices during the coding phase.

Testing and Deployment

Testing is a critical phase in the smart contract development lifecycle. Tools like Ganache and Remix offer testing environments where developers can simulate blockchain conditions and evaluate how their smart contracts perform. Comprehensive testing helps identify and address potential vulnerabilities, ensuring the security and reliability of the contract.

Once thoroughly tested, smart contracts are deployed to the blockchain network. Ethereum, for example, provides a straightforward deployment process using tools like Remix or Truffle. The deployment phase involves submitting the contract code to the blockchain, creating a new instance of the contract, and making it accessible for interaction.

Conclusion

The redefinition of smart contracts through innovations in blockchain technology marks a transformative era in digital agreements. From Ethereum's pioneering role in popularizing smart contracts to the dynamic approach of platforms like Binance Smart Chain, these innovations showcase the versatility and potential of decentralized automation.

Overcoming challenges such as scalability and regulatory uncertainties remains pivotal, while ongoing advancements promise a future where smart contracts seamlessly integrate with emerging technologies. As this evolution continues, smart contracts stand poised to revolutionize industries, providing secure, efficient, and trustless solutions to redefine the way transactions and agreements unfold in the digital age.

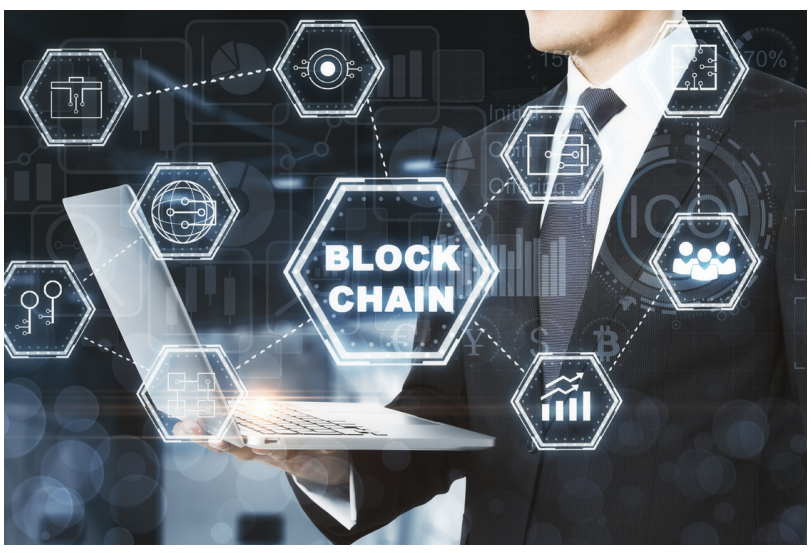
Taken from: https://medium.com/@comfygenpvt/smart-contracts-redefined-innovations-in-blockchain-technology-2cd7b498a9b5#:~:text=Smart%20contracts%20represent%20a%20groundbreaking,agreement%20directly%20written%20into%20code.

10. Inference multiple choice activity.

Cuestionario Online

11. Socialize key words about "How to develop secure and optimized blockchain smart contracts?"

1. Smart Contract Testing: Automated verification to ensure proper smart contract functionality, detect security gaps, and identify irregularities in early development.



3. Open Zeppelin Library: Trusted collection of secure smart contracts, used in DeFi protocols, providing implementations for ERC standards and access control extensions.

2. Tool Configuration: Set up tools like solidity-coverage and slither to measure code quality, perform static analysis, and enhance security in blockchain software.

5. Learning from Mistakes: Gain security insights by studying real-world smart contract vulnerabilities, understanding past developer mistakes, and learning from documented cases for improved coding practices.

4. Solidity Language Versions: Use the latest Solidity language versions for access to new features, bug fixes, and security updates, enhancing overall smart contract safety.

12. Reading comprehension #3: "How to develop secure and optimized blockchain smart contracts?"

How to develop secure and optimized blockchain smart contracts? – 5 rules | Nextrope Academy

How to develop secure and optimized blockchain smart contracts? – 5 rules | Nextrope Academy

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Summary

Why is the security of smart contracts important?

Smart contracts are a major part of applications based on blockchain technology. In the development process of smart contracts, we should maintain the highest security standards because of factors such as:

In many systems, they are responsible for the most critical functionality, the incorrect operation of which can be associated with a number of very unpleasant consequences, including irreversible loss of funds, a logical error ruining the operation of the entire application/protocol,a smart contract that has already been published on the web cannot be modified.

This feature means that bugs and vulnerabilities that are diagnosed after the contract is launched productionally cannot be fixed. (There is an advanced technique to create "upgradeable contracts," which allows the contract logic to be modified later, but it also has a number of other drawbacks and limitations that do not relieve the developer from writing secure code. For the purposes of this article, we will skip a detailed analysis of this solution).

The source code of most contracts is publicly available. It is good practice to publish the source code in services such as Etherscan which significantly increases the credibility of the application data or defi protocols. However, making the code publicly available entails that anyone can verify such code for security, and use any irregularities to their advantage.

Learning to write secure smart contracts is a process that requires learning many advanced aspects of the Solidity language. In this article, we will present 5 tips to simplify this process and secure our software from the most common mistakes.

1. Accurate testing of smart contracts

The first, and at the same time the most important factor that allows us to verify that our contract works properly is writing automated tests. The testing process usually allows us to reveal various security gaps or irregularities at an early stage of development.

Another advantage of automated tests is protection against code regression, i.e. a situation when during implementation of new functionalities bugs are created in previously written code. In such tests we should check all possible scenarios, 100% code coverage with tests should not be a goal in itself, but only a measure to help us make sure that tests scrupulously check every method on our contract.

2. Configuration of additional tools

It is worthwhile to make use of tools that are able to measure and check the quality of the software we provide. Tools you should use in your daily work are:

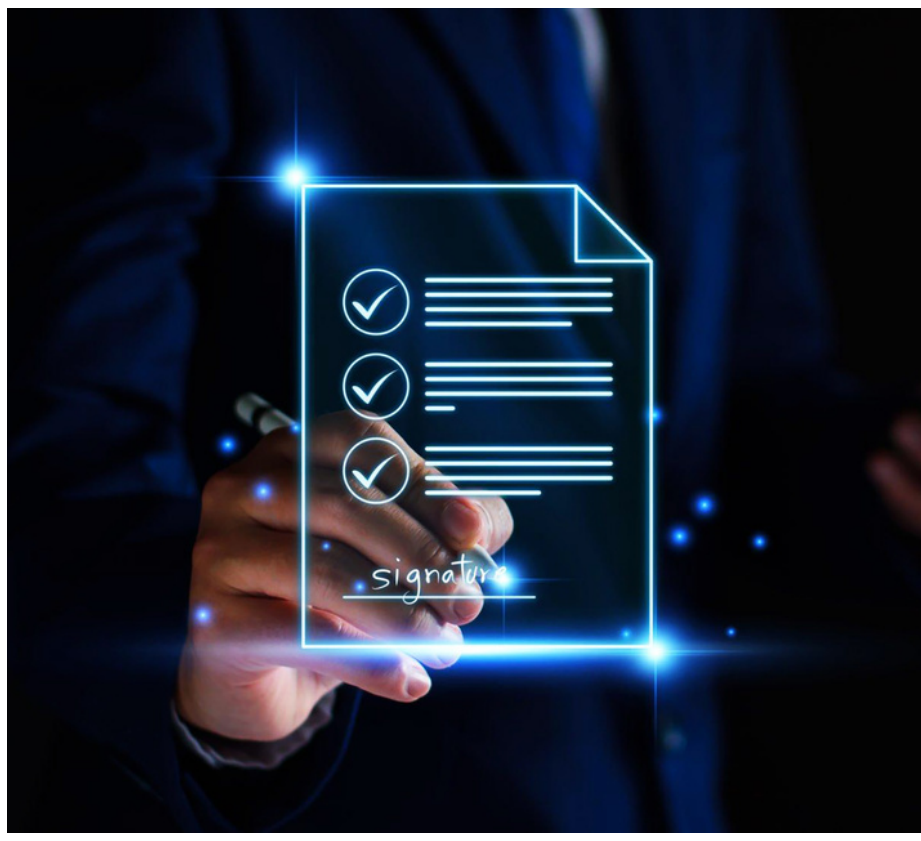
A plugin for measuring code coverage e.g. solidity-coverage. Expanding on the thought from the first point that code coverage should not be an end in itself, it is nevertheless worth having such analytics in the testing process. By analyzing code coverage with tests, we are able to easily see which code fragments require us to write additional tests.

Framework for static code analysis e.g. slither, mythril. These are tools that, with the help of static analysis, are able not only to point out places in our code where a vulnerability exists, but also to offer a number of tips. Following these tips can improve not only the security, but also the quality of our software.

3. Openzeppelin smart contract library

There are many libraries and ready-made contracts that have been prepared for later use by developers of blockchain applications. However, each of these libraries needs to be verified before use to see if it has any vulnerabilities. The most popular library at the moment is open zeppelin. It is a collection of secure, tested smart contracts used in many of DeFi's most popular protocols such as uniswap. It allows us to use the most commonly used implementations of ERC (Ethereum Request For Comments) standards and reusable contracts.

The library has a large range of components that can be used to implement the most popular functionalities on the smart contract side. I will give two applications of the library as examples. However, we believe it is worth exploring all the capabilities and contracts that are provided there.



Ownable and Access Control extensions.
These extensions allow us to very easily add access control to functions that, according to business requirements, should only be available for execution to authorized addresses. An example from the documentation showing the use of the Ownable extension in practice:

As you can see, using the open zeppelin library is not only very easy, but also allows you to write more concise code that other developers can understand.

Implementations of the popular token standards ERC-20, ERC-721 and ERC-1155.
Many decentralized applications and protocols are based on ERC-20 or NFT tokens. Each token must have an implemented interface that works according to the specification. Implementing a token entirely on your own is associated with a high risk of error, so our token may have security holes or problems with operation on various exchanges and wallets. With the help of the open zeppelin library we are able to prepare a standard, functional token and enrich it with the most popular extensions with little effort.

A good place to start is the interactive token configurator in the open zeppelin documentation, it allows us to generate token source code that will meet functional requirements and security standards.

4. Using new versions of the Solidity language

An important safety tip is that projects should use new versions of the Solidity language. The compiler requires us to include Solidity version information at the beginning of each source file with a .sol extension:
Pragma solidity 0.8.17

Along with new versions of the language, new features are introduced, but in addition to this, it is also important that fixes are added to various kinds of known bugs. A list of the bugs found in each version can be found in this file. As you can see, with newer versions of the language the number of bugs decreases and is successively fixed.

The language's developers in the official documentation also recommend using the latest version in newly implemented smart contracts:

“When deploying contracts, you should use the latest released version of Solidity. Apart from exceptional cases, only the latest version receives security fixes”.

5. Learning from other people's mistakes

An essential factor for delivering secure software is the sheer knowledge of the advanced aspects of the Solidity language, as well as awareness of potential threats. In the past, we have witnessed many vulnerabilities where multi-million dollar assets fell prey to the attacker.

Many examples of such incidents can be found on the Internet, along with detailed information on what mistake was made by the developers and how it could have been prevented. An example of the above is an article explaining the "reentrancy" attack, with the help of which the attacker stole $150 million worth of ETH.

The list of possibilities for attacking smart contracts is definitely longer, so it is worth reading the list of the most popular vulnerabilities in Solidity. A good way to learn security is also to take on the role of an attacker, for this purpose the Ethernaut service is worth a look.

There you will find a collection of tasks involving hacking various smart contracts, these tasks will help consolidate previously acquired security knowledge and learn new advanced aspects of the Solidity language.

Summary

In conclusion, software security of decentralized applications is a very important, but also difficult issue requiring knowledge of not only the programming language itself.

Also required are testing skills, a willingness to constantly explore the topic of smart contract vulnerabilities, knowledge of new libraries and tools.

This topic is vast and complicated and the above 5 points are just guidelines that can help improve the security of our code and with the associated learning. Also take a look at other articles in the Nextrope Academy series, where we take a closer look at other technical issues.

Taken from: https://nextrope.com/security-of-smart-contracts-5-rules-for-writing-safe-smart-contracts-nextrope-academy/

13. True/Flase - Activity

Actividad Online