

# Smart Contract Development In Solidity

pseudoyu | October 16, 2023

# About me



**pseudoyu ([x.com/pseudo\\_yu](https://x.com/pseudo_yu))**

Blockchain developer | [github.com/pseudoyu](https://github.com/pseudoyu)

- Tech writer/content creator | [pseudoyu.com](https://pseudoyu.com)
- Back-end dev at [RSS3](#)
- Smart contract dev at [Crossbell](#)
- Solidity courses/tutorials contributor of [OpenBuild](#)



# Own your social activities

Crossbell is a **social ownership** platform to build cutting-edge social dApps. Delight in seamless developer integration and smooth end-user experiences. Embrace the future of social networking.

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A Developer Community  
**Bridges Web2 to Web3**  
Connects Builders & Business



# Who is OpenBuild



<https://openbuild.xyz>



[openbuildxyz](https://github.com/OpenBuildxyz)



[@OpenBuildxyz](https://twitter.com/OpenBuildxyz)



[@OpenBuildxyz](https://youtube.com/c/OpenBuildxyz)

We're excited to introduce OpenBuild, an open-source community & platform for Web3 developers, offering a tailored learning and practice platform for all skill levels.

OpenBuild aims to bridge Web2 and Web3, helping developers transition to the decentralized web, enhance their skills, and display their expertise. Our mission is to provide essential tools and resources, foster trust with an on-chain reputation system, and create business opportunities.

Developers can earn NFT certificates, bounties, and improve their coding skills by building projects. They can also gain business opportunities due to their Web3 development capabilities, ultimately contributing to the development of decentralized networks.

## Our Past Developer Events

OpenBuild



April 10th to 14th

### OpenBuild Hackerhouse Series @HongKong

Co-host with Foresight to hold Hacker House Series@HongKong , Over **350** developers from **16** countries registered, **64** submissions in total. Over 30 guests conducted 10 workshops and 16 roundtable discussions, Developer workshop submissions showcase

Github link: [ForesightX-HackerHouse-HK](#)

Partners with **Scroll**, **Starknet**, **Sei**, **Consensys**, **Hashkey**, **Delphi Digital**, **the Beacon**, **Chainlink**, etc.

FORESIGHT X | Generative Ventures

### OpenBuild Hackerhouse EthCC

Empowering A Trustless Future

7-day immersive hacking  
with accommodation provided

10+ OGs guests and mentors  
top communities to connect



July 16th to 23rd

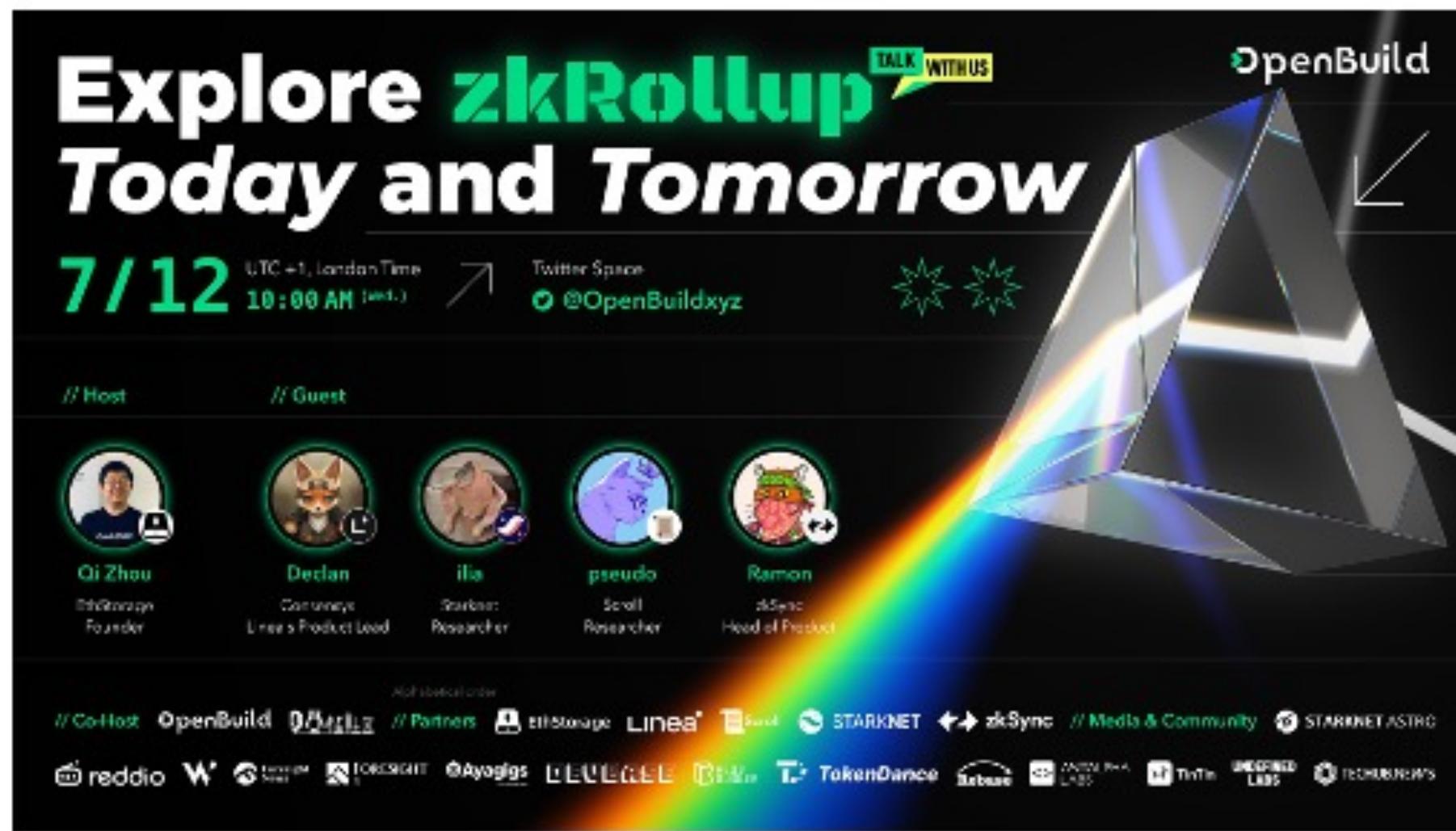
### OpenBuild Hacker House Series @EthCC:

Collaborate with Foresight to hold Hacker House Series @EthCC. Received more than **200** applications and Accepted 11 exceptional staying hackers. Among them, 4 staying hackers were nominated as **EthGlobal finalists**, 3 members secured the first and second prizes in the **LambdaZkWeek hackathon**, and other members won multiple bounty awards.

Partners with **EF PSE**, **Linea**, **Ethstorage**, **Herodotus**, **Kakarot**, **Beerus**, **Nethermind Modulus Labs**, etc.

## Our Past Developer Events

OpenBuild



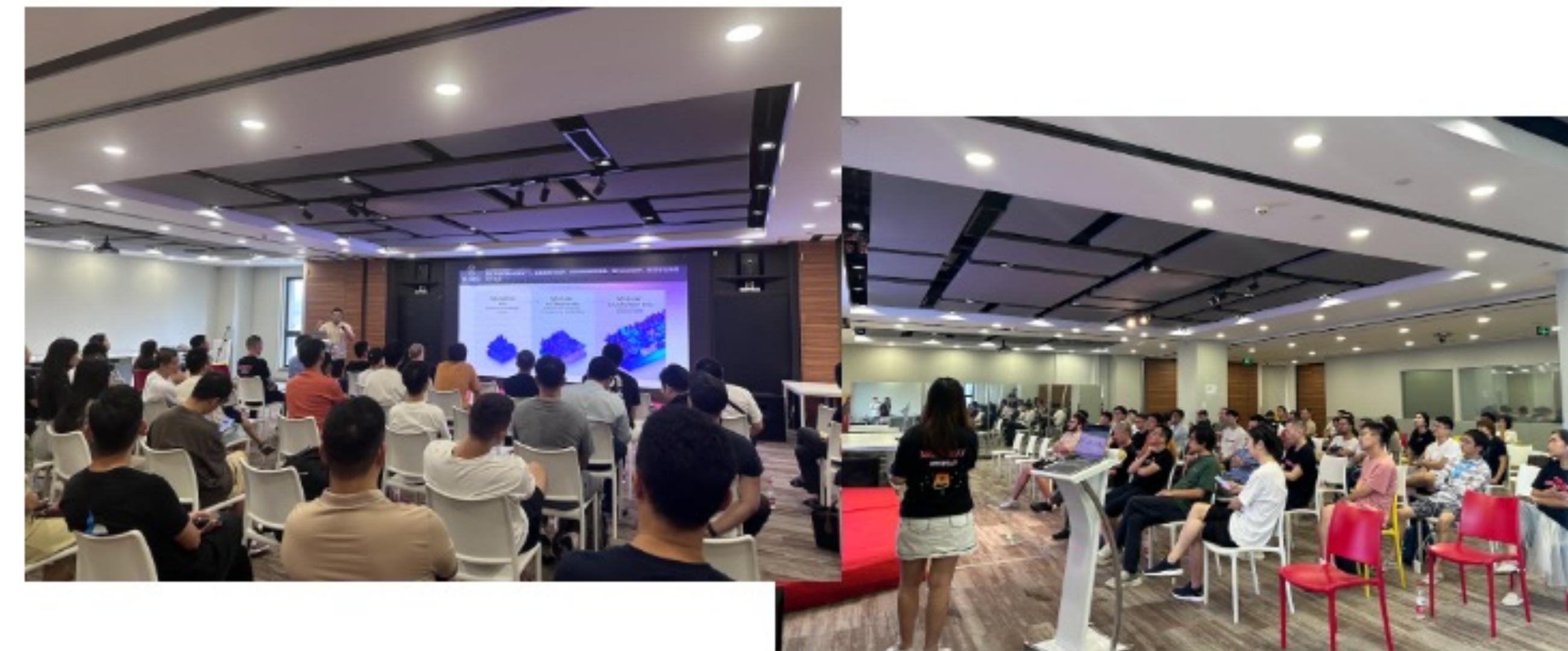
July 12th

### Explore zkRollup Today and Tomorrow

Twitter Space event for a deep dive into the current state and future possibilities of zkRollup technology.

A total of **7.6K** audience participation, average of **500** audience listening at the same time

Partners with **Starknet**, **zkSync**, **Scroll**, **Linea**, **EthStorage**, etc.



September 12

### Modular Meetup Shanghai

Hosted during Shanghai Blockchain Week, we invite experts and developers from the modular blockchain space to explore the latest trends and technical implementations of modular blockchain.

About **120** developers registered, and more than **60** developers participated on-site.  
Partners with **Celestia**, **EthStorage**, **Manta**, **Rooch**, **Octopus**, etc.

# What's Smart Contract

**Smart contracts are programs that run on the blockchain**  
**Contract developers can interact with on-chain assets and data**  
**through smart contracts**  
**Users can call contracts, access assets and data**  
**through their own on-chain accounts**

# Differences from the general programs

**Native support for asset**

**Deployment and transactions require certain costs**

**The cost of storing data is higher**

**Unable to modify after deployment (Upgradable smart contracts?)**

...

# Solidity

**A high-level programming language for the implementation of smart contracts**

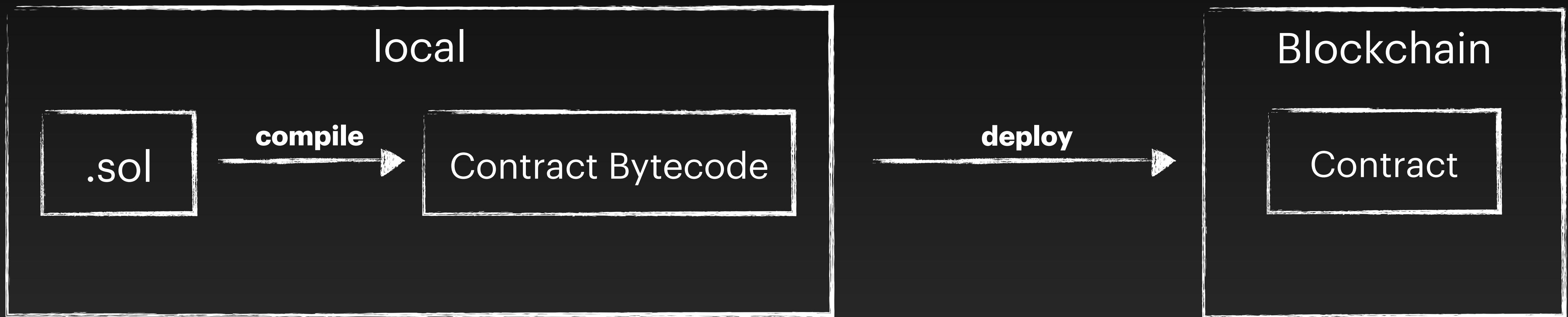
**Run on the EVM**

**The syntax is similar to JavaScript**

**The most popular smart contract language**

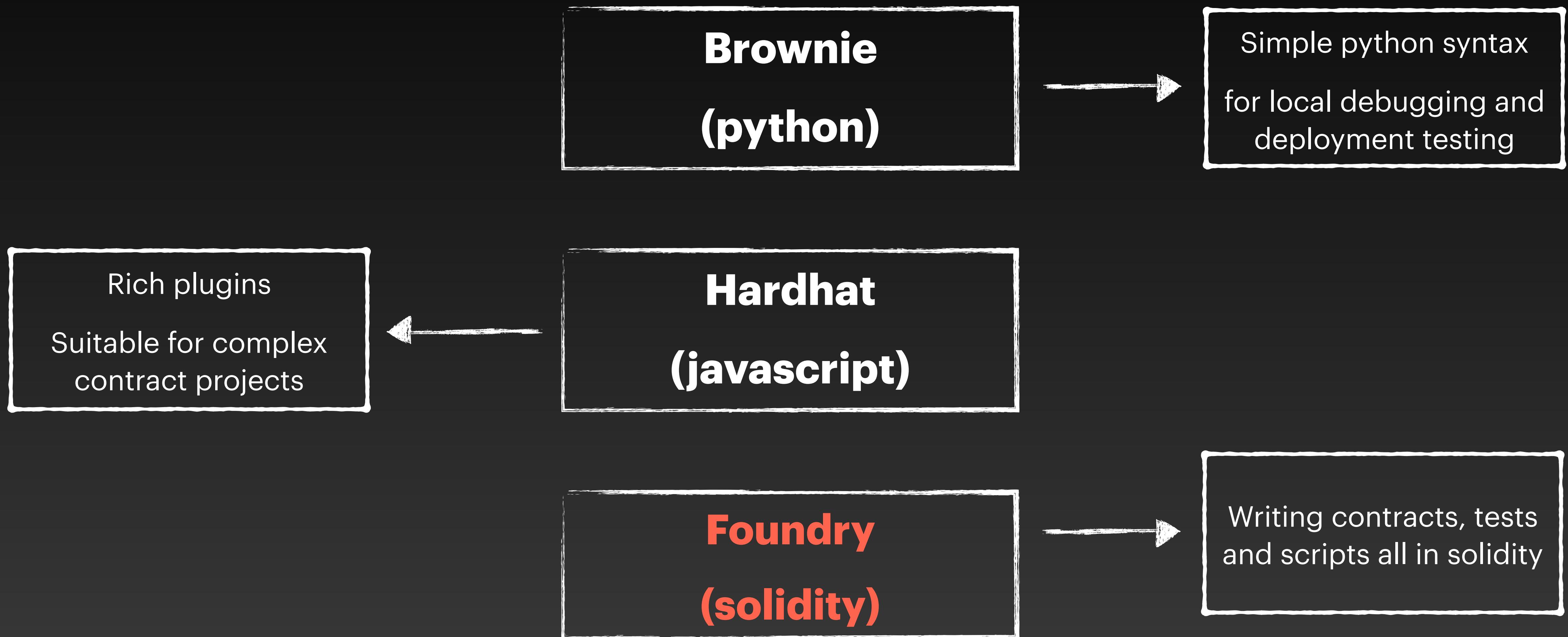
**The language you need to know to get started with blockchain and web3**

# How to Deploy Smart Contracts

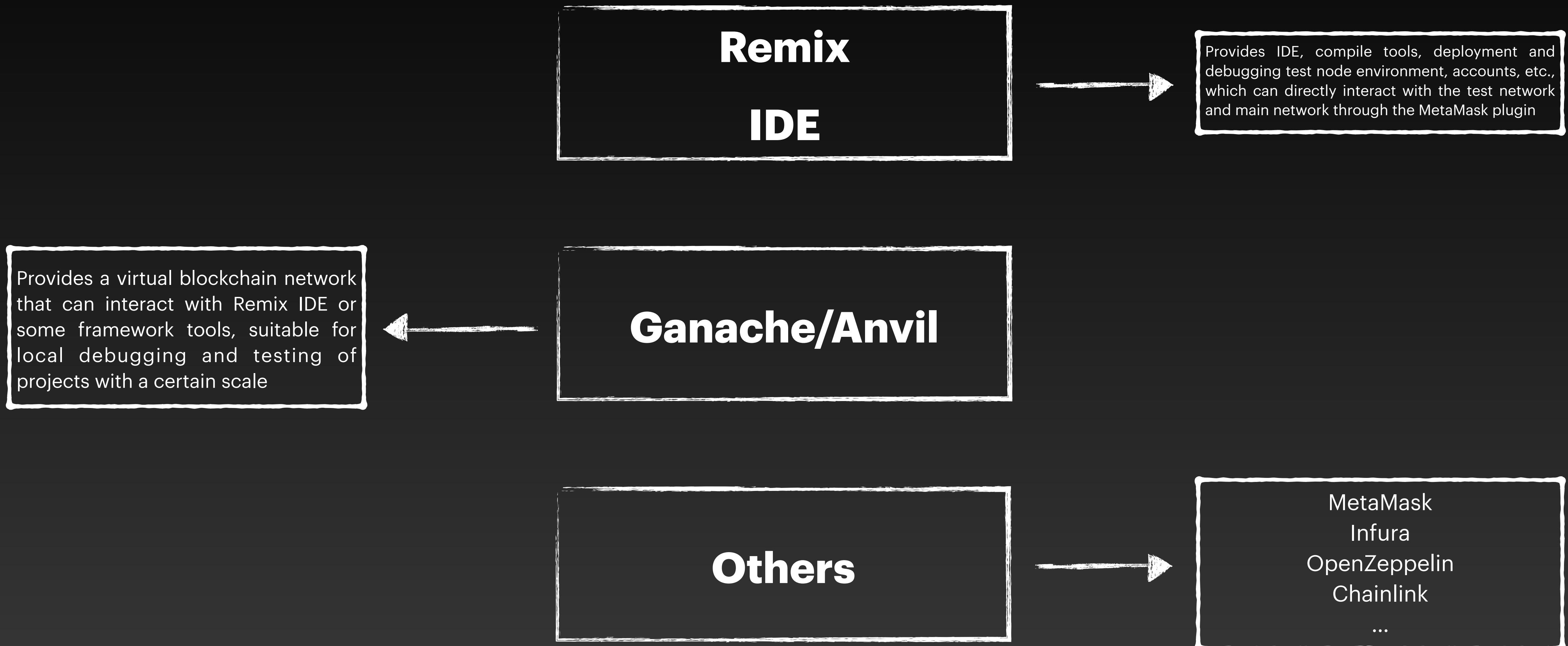


**Solidity contracts are files with the .sol extension and cannot be executed directly. They need to be compiled into bytecode that can be recognized by the Ethereum Virtual Machine (EVM) in order to run on the blockchain.**

# Development Frameworks & Tools



# Development Frameworks & Tools



*Solidity Core*

# Data Type

## Basic

boolean

int

uint

**address**

bytes

...

# Data Type enum

```
enum Status {  
    Unknown,  
    Start,  
    End,  
    Pause  
}  
  
// 实例化枚举类型  
Status public status;  
  
// 更新枚举值  
function pause() public {  
    status = Status.Pause;  
}  
  
// 初始化枚举值  
function reset() public {  
    delete status;  
}
```

# Data Type array



```
// 定义数组类型
uint[7] public arr;

// 添加数据
arr.push(7);

// 删除最后一个数据
arr.pop();

// 删除某个索引值数据
delete arr[1];

// 获取数组长度
uint len = arr.length;
```

# Data Type mapping



```
// 定义嵌套 mapping 类型
mapping(string => mapping(string => string)) nestedMap;

// 设置值
nestedMap[id][key] = "0707";

// 读取值
string value = nestedMap[id][key];

// 删除值
delete nestedMap[id][key];
```

# Data Type struct

```
contract Struct {  
    struct Data {  
        string id;  
        string hash;  
    }  
  
    Data public data;  
  
    // 添加数据  
    function create(string calldata _id) public {  
        data = Data{id: _id, hash: "111222"};  
    }  
  
    // 更新数据  
    function update(string _id) public {  
        // 查询数据  
        string id = data.id;  
  
        // 更新  
        data.hash = "222333"  
    }  
}
```

# Variable

## Type

local

state

global

## Keywords

storage

memory

calldata

**constant**  
/  
**immutable**

**constant**

can't be changed

reduce gas fee

**immutable**

can be initiated in constructor

but can't be changed later

# Function Visibility and Keywords

## Visibility

public

private

internal

external

## Keywords

view

pure

# Function modifier

```
modifier onlyOwner() {
    require(msg.sender == owner, "Not owner");
    _;
}

modifier validAddress(address _addr) {
    require(_addr != address(0), "Not valid address");
    _;
}

modifier noReentrancy() {
    require(!locked, "No reentrancy");
    locked = true;
    _;
    locked = false;
}

function changeOwner(address _newOwner) public onlyOwner validAddress(_newOwner) {
    owner = _newOwner;
}

function decrement(uint i) public noReentrancy {
    x -= i;

    if (i > 1) {
        decrement(i - 1);
    }
}
```

# Function selector

```
addr.call(abi.encodeWithSignature("transfer(address,uint256)", 0xSomeAddress, 123))

contract FunctionSelector {
    function getSelector(string calldata _func) external pure returns (bytes4) {
        return bytes4(keccak256(bytes(_func)));
    }
}
```

# Condition

## if / else if / else

```
● ● ●  
if (x < 10) {  
    return 0;  
} else if (x < 20) {  
    return 1;  
} else {  
    return 2;  
}  
  
x < 20 ? 1 : 2;
```

# Loop

## for / while / do while



```
for (uint i = 0; i < 10; i++) {  
    // 业务逻辑  
}  
  
uint j;  
while (j < 10) {  
    j++;  
}
```

# Contract constructor



```
constructor(string memory _name) {  
    name = _name;  
}
```

# Contract interface

```
contract Counter {
    uint public count;

    function increment() external {
        count += 1;
    }
}

interface ICounter {
    function count() external view returns (uint);
    function increment() external;
}

contract MyContract {
    function incrementCounter(address _counter) external {
        ICounter(_counter).increment();
    }

    function getCount(address _counter) external view returns (uint) {
        return ICounter(_counter).count();
    }
}
```

# Contract Inheritance

```
// 定义父合约 A
contract A {
    function foo() public pure virtual returns (string memory) {
        return "A";
    }
}

// B 合约继承 A 合约并重写函数
contract B is A {
    function foo() public pure virtual override returns (string memory) {
        return "B";
    }
}

// D 合约继承 B、C 合约并重写函数
contract D is B, C {
    function foo() public pure override(B, C) returns (string memory) {
        return super.foo();
    }
}

contract B is A {
    function foo() public virtual override {
        // 直接调用
        A.foo();
    }

    function bar() public virtual override {
        // 通过 super 关键字调用
        super.bar();
    }
}
```

# Contract create

```
function create(address _owner, string memory _model) public {
    Car car = new Car(_owner, _model);
    cars.push(car);
}
```

```
function create2(address _owner, string memory _model, bytes32 _salt) public {
    Car car = (new Car){salt: _salt}(_owner, _model);
    cars.push(car);
}
```

# Contract import

```
● ● ●  
// 本地导入  
import "./Foo.sol";  
  
// 外部导入  
import "https://github.com/owner/repo/blob/branch/path/to/Contract.sol";
```

# Contract import library

```
library SafeMath {
    function add(uint x, uint y) internal pure returns (uint) {
        uint z = x + y;
        require(z >= x, "uint overflow");
        return z;
    }
}

contract TestSafeMath {
    using SafeMath for uint;
}
```

# Contract event



```
// 定义事件
event Log(address indexed sender, string message);
event AnotherLog();

// 抛出事件
emit Log(msg.sender, "Hello World!");
emit Log(msg.sender, "Hello EVM!");
emit AnotherLog();
```

# Error Handling

## require / revert / assert

```
function testRequire(uint _i) public pure {
    require(_i > 10, "Input must be greater than 10");
}

function testRevert(uint _i) public pure {
    if (_i <= 10) {
        revert("Input must be greater than 10");
    }
}

function testAssert() public view {
    assert(num == 0);
}
```

# Error Handling

## try / catch

```
event Log(string message);
event LogBytes(bytes data);

function tryCatchNewContract(address _owner) public {
    try new Foo(_owner) returns (Foo foo) {
        emit Log("Foo created");
    } catch Error(string memory reason) {
        emit Log(reason);
    } catch (bytes memory reason) {
        emit LogBytes(reason);
    }
}
```

# Assets payable



```
// 地址类型可以声明 payable
address payable public owner;

constructor() payable {
    owner = payable(msg.sender);
}

// 方法声明 payable 来接收 Ether
function deposit() public payable {}
```

# Assets send

```
● ● ●  
  
contract SendEther {  
    function sendViaCall(address payable _to) public payable {  
        (bool sent, bytes memory data) = _to.call{value: msg.value}("");  
        require(sent, "Failed to send Ether");  
    }  
}
```

# Assets receive

```
contract ReceiveEther {  
  
    // 当 msg.data 为空时  
    receive() external payable {}  
  
    // 当 msg.data 非空时  
    fallback() external payable {}  
  
    function getBalance() public view returns (uint) {  
        return address(this).balance;  
    }  
}
```

# Assets

## Gas Fee

### params

gas spent

gas price

gas limit

block gas limit

### tips

use calldata instead of memory

load state variables into memory

cache array elements

...

# References

## **Demo code repository**

<https://github.com/pseudoyu/social-dApp-demo-contracts>

## **Solidity Smart Contract Development - Basics**

[https://www.pseudoyu.com/zh/2022/05/25/learn\\_solidity\\_from\\_scratch\\_basic/](https://www.pseudoyu.com/zh/2022/05/25/learn_solidity_from_scratch_basic/)

## **foundry-starter-kit**

<https://github.com/pseudoyu/foundry-starter-kit>

## **Other resources**

[Solidity by Example](#)

[Learn Solidity, Blockchain Development, & Smart Contracts](#)

# Thank you!

emit Log(msg.sender, "Thank You");