Smart contract development with TokenSPICE & Brownie

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http://trent.st/content/pycon.pdf

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Overview

Who this talk is for:

- Py / ML developers
- Who are blockchain-curious
- Who could quickly become blockchain ninjas but don’t know it yet!

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Outline

- Ninja strategy #1: a useful cheat

- Smart contracts background
- Ninja strategy #2: for rest of talk

- Py skills →Brownie
- ML algs → blockchain algs
- Py + ML skills →TokenSPICE

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Ninja Strategy #1:
A useful cheat

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Py + ML without Solidity dev, for ML use cases

Tokenize data & algorithms, share it, sell it (Ocean)

github.com/oceanprotocol/ocean.py

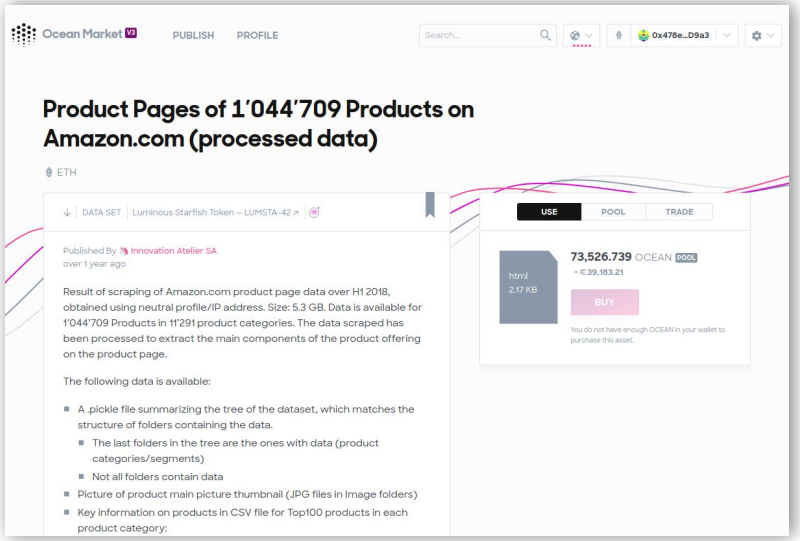
Publish datatokens

In the Python console:

```python
import os
from ocean_lib.example_config import ExampleConfig
from ocean_lib.ocean.ocean import Ocean
from ocean_lib.web3_internal.wallet import Wallet

private_key = os.getenv('TEST_PRIVATE_KEY1')
config = ExampleConfig.get_config()
ocean = Ocean(config)

print("create wallet: begin")
wallet = Wallet(ocean.web3, private_key, config.block_confirmations, config.transaction_timeout)
print(f"create wallet: done. Its address is {wallet.address}")

print("create datatoken: begin.")
datatoken = ocean.create_data_token("Dataset name", "dtsymbol", from_wallet=wallet)
print(f"created datatoken: done. Its address is {datatoken.address}")
```

Congrats, you've created your first Ocean datatoken! 🐳

[market.oceanprotocol.com](https.://market.oceanprotocol.com)



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Background on Smart Contracts

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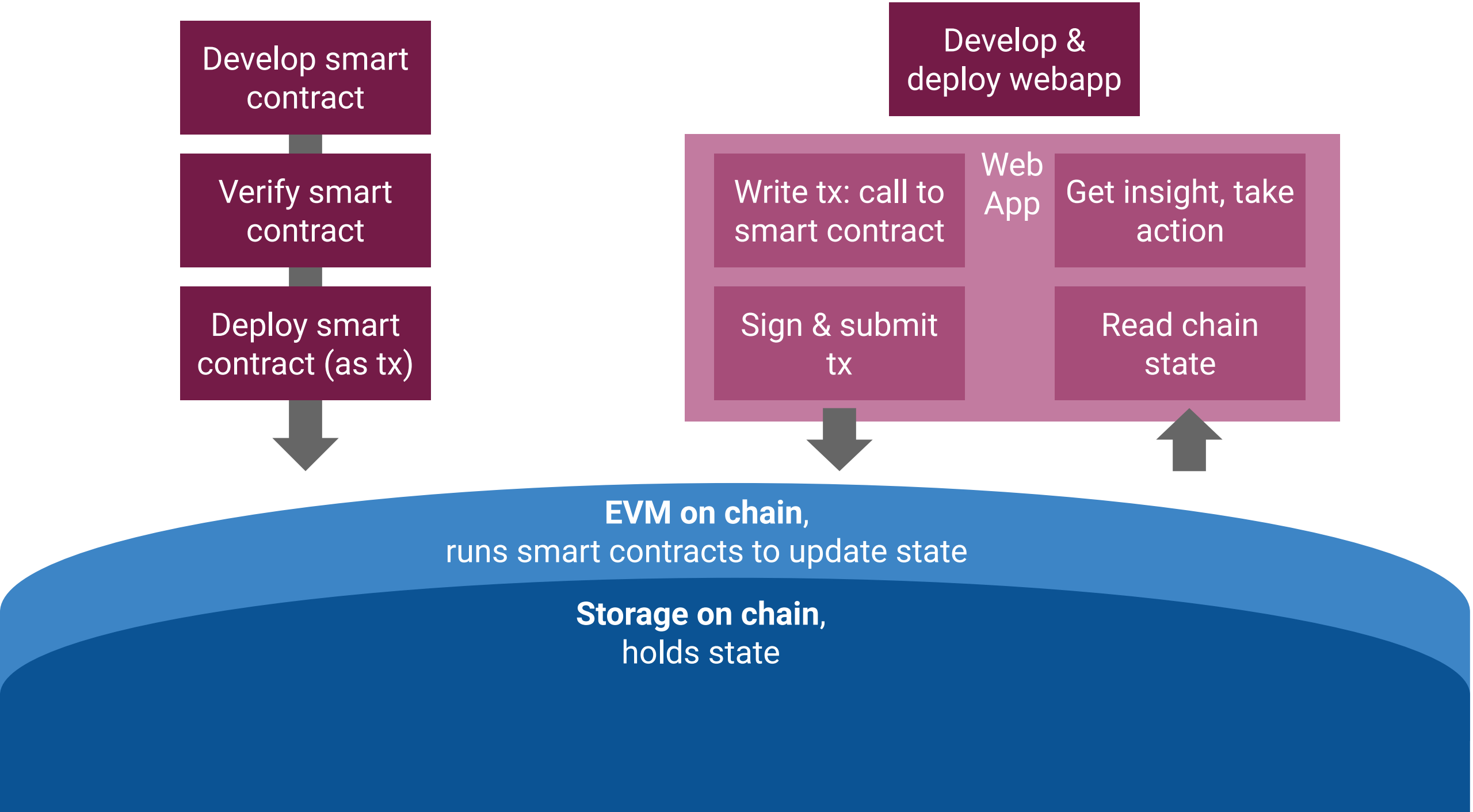
Develop smart contract
Verify smart contract
Deploy smart contract (as tx)
Develop & deploy webapp
Web App
Write tx: call to smart contract
Get insight, take action
Sign & submit tx
Read chain state
EVM on chain,
runs smart contracts to update state
Storage on chain,
holds state

What a smart contract looks like (Solidity code)

```
function createToken(
    string memory blob,
    string memory name,
    string memory symbol,
    uint256 cap
)
    public
    returns (address token)
{
    require(
        cap != 0,
        'DTFactory: zero cap is not allowed'
    );

    token = deploy(tokenTemplate);

    require(
        token != address(0),
        'DTFactory: Failed to perform minimal deploy of a new token'
    );
    IERC20Template tokenInstance = IERC20Template(token);
    require(
        tokenInstance.initialize(
            name,
            symbol,
            msg.sender,
            cap,
            blob,
            communityFeeCollector
        ),
        'DTFactory: Unable to initialize token instance'
    );
    emit TokenCreated(token, tokenTemplate, name);
```

```
/**
 * @dev mint
 *      Only the minter address can call it.
 *      msg.value should be higher than zero and gt or eq minting fee
 * @param account refers to an address that token is going to be minted to.
 * @param value refers to amount of tokens that is going to be minted.
 */
function mint(
    address account,
    uint256 value
)
    external
    onlyMinter
{
    require(
        totalSupply().add(value) <= _cap,
        'DataTokenTemplate: cap exceeded'
    );
    _mint(account, value);
}
```

https://github.com/oceanprotocol/contracts

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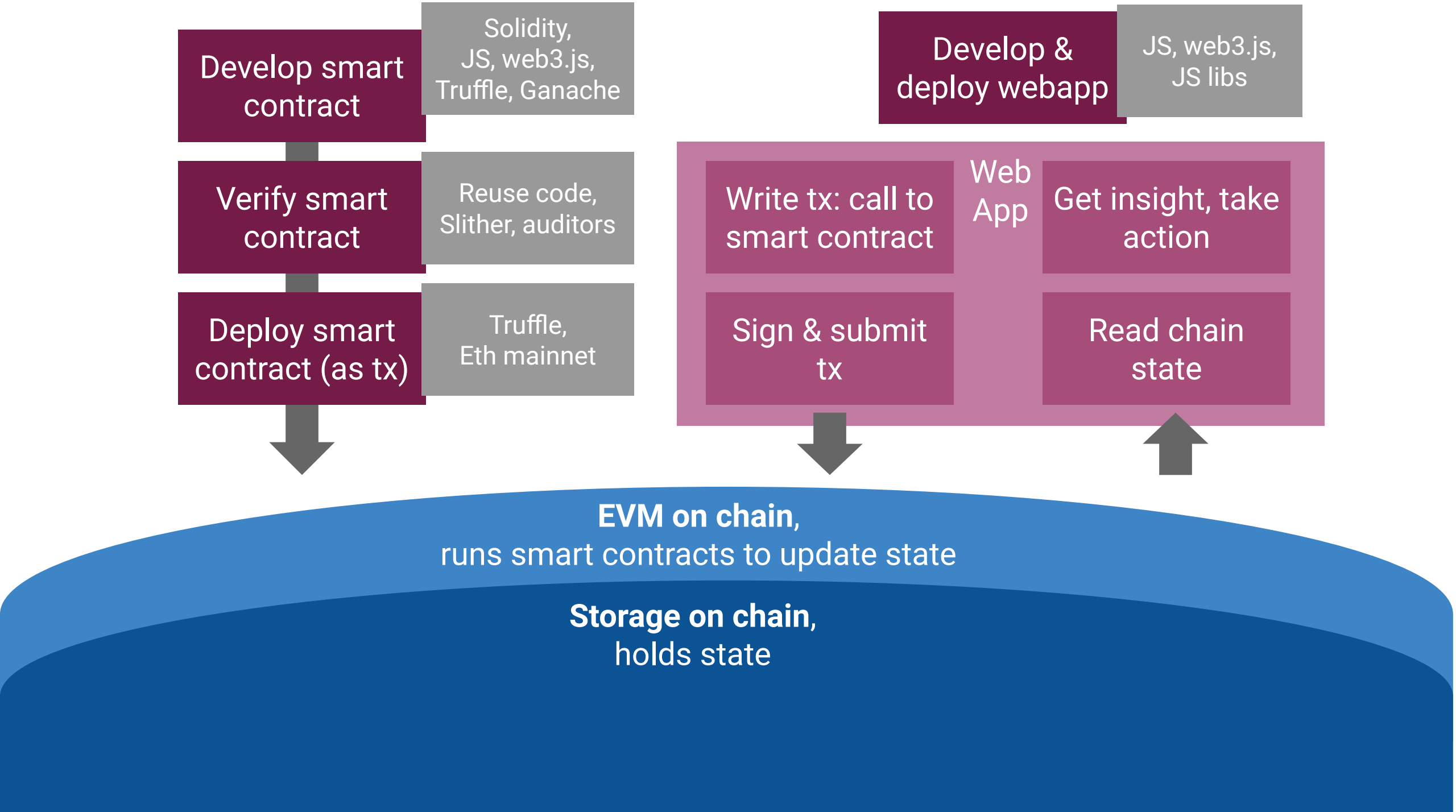
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Solidity, JS, web3.js, Truffle, Ganache
Verify smart contract
Reuse code, Slither, auditors
Deploy smart contract (as tx)
Truffle, Eth mainnet
Develop & deploy webapp
JS, web3.js, JS libs
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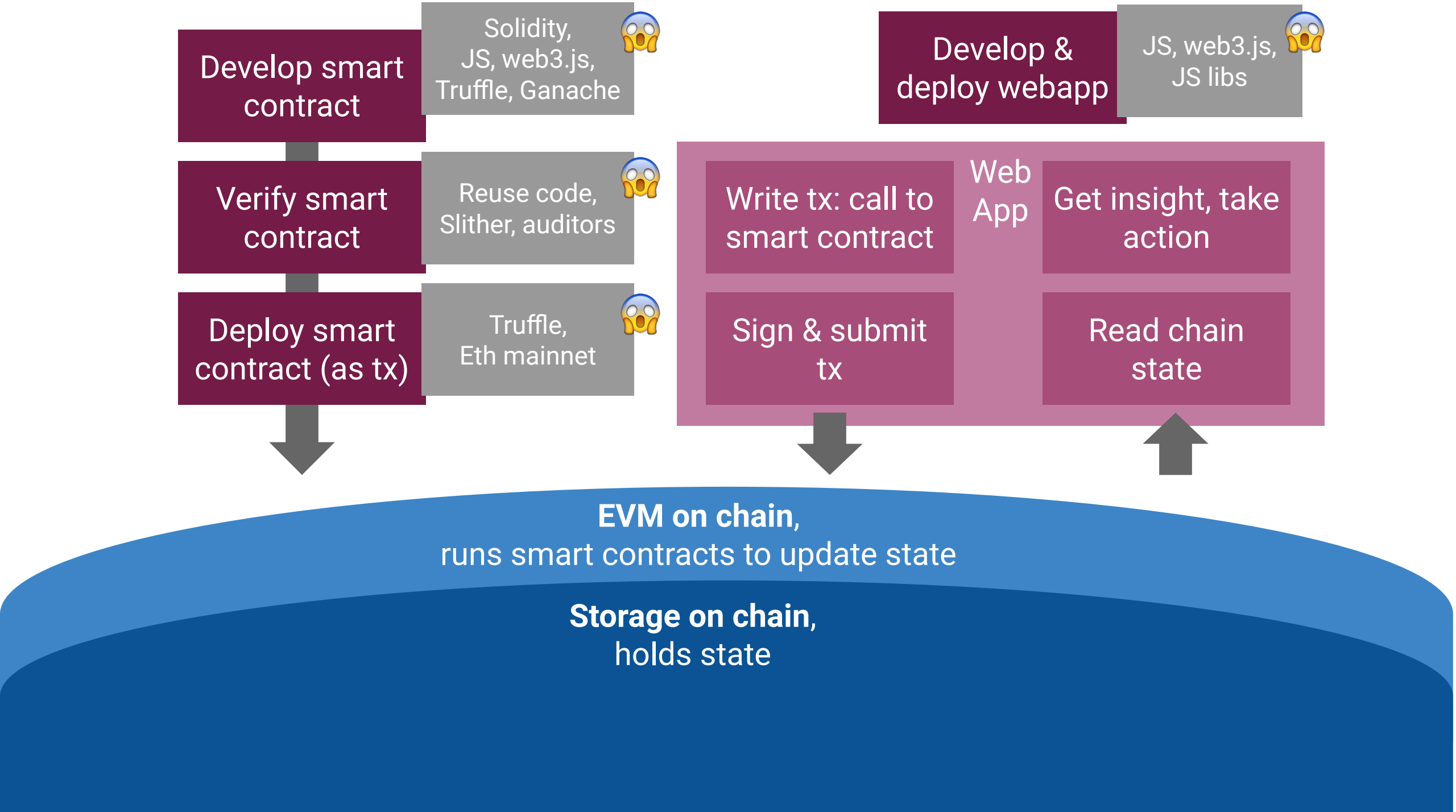
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Motivation

Why blockchain could look daunting to MLers:

- Different languages: Solidity, JS
- Different tools: Web3.js, Truffle, Ganache, ..
- Different building blocks: ERC20, ERC721, AMMs, multisig, DAOs, ..

Extra Worries:

- Is it start from zero? It looks like a long / steep learning curve
- Is it worth it? It looks like building webapps, not ML algorithms. Different style.

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Ninja Strategy #2:
Strategy for rest of talk

What if…

- Solidity, JS → **Mostly Py**, some Solidity
- Web3.js, Truffle, Ganache → **Brownie (Py)**, Ganache (but hidden)
- ERC20, ERC721, AMMs, multisig, DAOs → **treat as Py classes/objects: Brownie**

- Start from zero → **Py & ML ninja skills are your big lever**
- Webapps, not ML-like algs → **ML-like algs via TokenSPICE (Py)**

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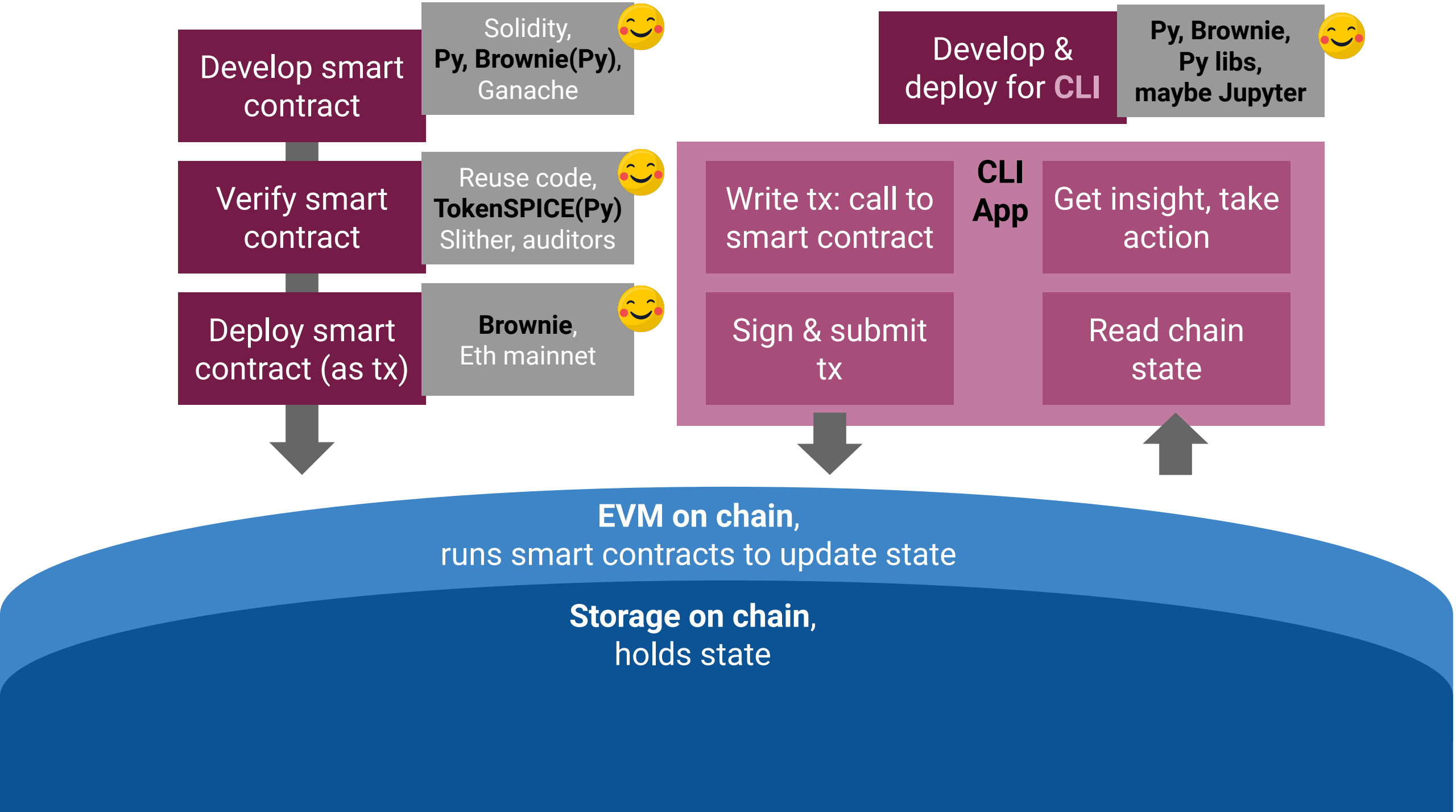
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Solidity, Py, Brownie(Py), Ganache
Verify smart contract
Reuse code, TokenSPICE(Py) Slither, auditors
Deploy smart contract (as tx)
Brownie, Eth mainnet
Develop & deploy for CLI
Py, Brownie, Py libs, maybe Jupyter
CLI App
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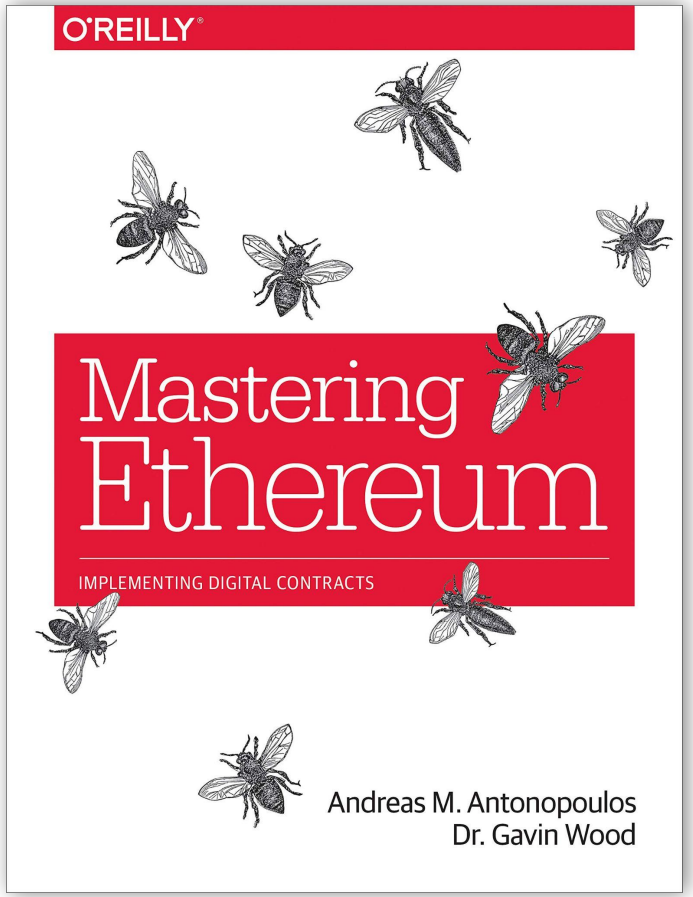
Learning Solidity



You still need Eth & Solidity basics.

This is the best path to a solid foundation.

amazon.com/Mastering-Ethereum-Building-Smart-Contracts/dp/1491971940/

And, JS not needed 😊

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Py skills →Brownie

Recall: what if…

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Brownie Quickstart

Let’s walk through **“Getting Started With Brownie”**

Part 1 - Install

Part 2 - Brownie projects

Part 3 - Basic functionality

1: https://iamdefinitelyahuman.medium.com/getting-started-with-brownie-part-1-9b2181f4cb99

2: https://betterprogramming.pub/getting-started-with-brownie-part-2-615a1eec167f

3: https://betterprogramming.pub/getting-started-with-brownie-part-2-615a1eec167f

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ML Algs → Blockchain Algs

Recall: what if…

- Webapps, not ML-like algs → **ML-like algs**

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Incentives & Blockchains

“Show me the incentive, and I will show you the outcome”
-- Charlie Munger

Incentives are conceptually easy in blockchain:
Get people to do stuff, by paying them in tokens.

How to implement incentives in blockchains:
Develop, verify, and deploy Solidity code

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From ML Algorithm Design To Incentive Design

How do we *design* the incentives?

This problem is a *lot* like ML algorithm design:

It's an optimization problem formulation!

Minimize fi(x)

S.t. gj(x) <= 0

And hk(x) = 0

This is design of analog / continuous-valued systems, vs digital / discrete.

In blockchain land, incentive design = **Token Engineering**.

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Verification

How do we *verify* the incentives?

Three ways:

1. Manual → human feedback
2. Economic → deploy live, ratchet up risk
3. Software-based → need appropriate SW

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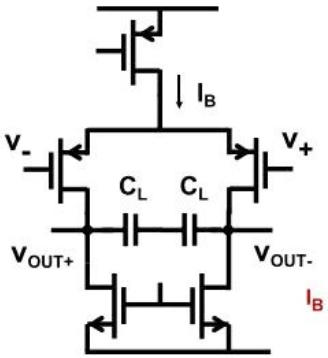
Verifying Continuous-Valued Systems: Analog Circuits

Design analog circuit

Verify with SPICE simulator

(Manufacture circuit)



$$GBW = \frac{g_{m1}}{2\pi C_L} \qquad g_{m1} = \frac{I_B}{V_{GS1}-V_T}$$

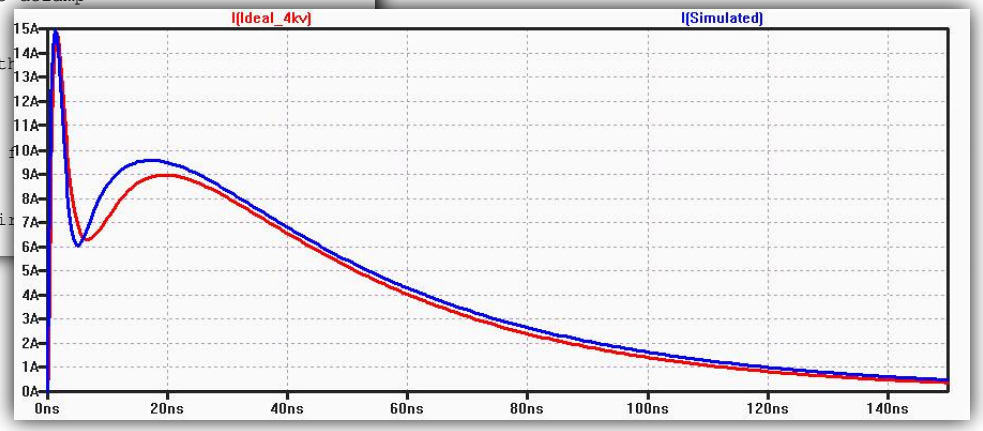
$$GBW_{max} = \frac{I_B}{V_{GS1}-V_T}\,\frac{1}{2\pi C_L}$$

0.2 V

$I_B = 10\ \mu A$ $C_L = 1$ pF $GBW_{max} \approx 10$ MHz [8]

$$FOM = \frac{GBW.C_L}{I_B} = 1000\ \text{MHzpF/mA} \quad [800]$$

```
SPICE sample circuit - diode clamp

*independent voltage source with DC value, AC value, and
*transient square wave. -10V to +20V extent, with 2ms period
V1 1 0 1 AC 1 pulse -10 20 0 1.e-8 1.e-8 1e-3 2e-3

*capacitor for clamping
C1 1 2 1e-6

*diode for clamp - model name is dclamp
D1 2 0 dclamp

*load resistor - large enought t
*model for diode
.model dclamp D(IS=1e-14)

*DC transfer function generated
.DC V1 -20 20 .1

*AC frequency sweep - assumes ci
```



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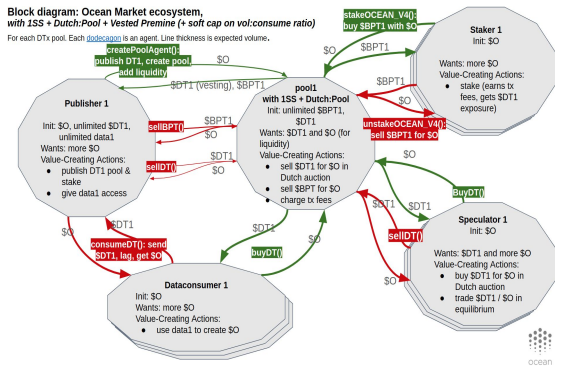
Verifying Continuous-Valued Systems: Incentives

Develop smart contract

Verify with TokenSPICE simulator

Deploy smart contract (as tx)

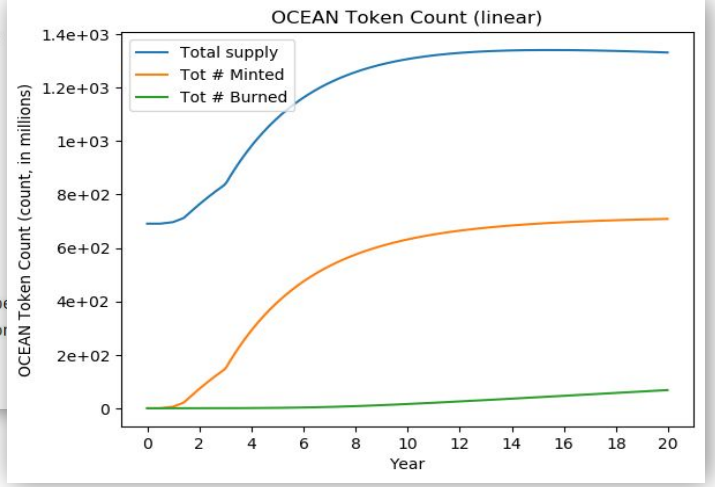



```
uint spotPriceBefore = calcSpotPrice(
    inRecord.balance,
    inRecord.denorm,
    outRecord.balance,
    outRecord.denorm,
    _swapFee
);
require(spotPriceBefore <= maxPrice, 'ERR_BAD_LIMIT_PRICE');

tokenAmountOut = calcOutGivenIn(
    inRecord.balance,
    inRecord.denorm,
    outRecord.balance,
    outRecord.denorm,
    tokenAmountIn
```

```
new_agents.add(
    PublisherAgent(
        name="publisher",
        USD=0.0,
        OCEAN=self.ss.publisher_init_OCEAN,
        pub_ss=pub_ss,
    )
)

new_agents.add(
    DataconsumerAgent(
        name="consumer",
        USD=0.0,
        OCEAN=self.ss.consumer_init_OCEAN,
        s_between_buys=self.ss.consumer_s_be
        profit_margin_on_consume=self.ss.con
    )
)
```



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Py + ML skills → TokenSPICE

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Recall: what if…

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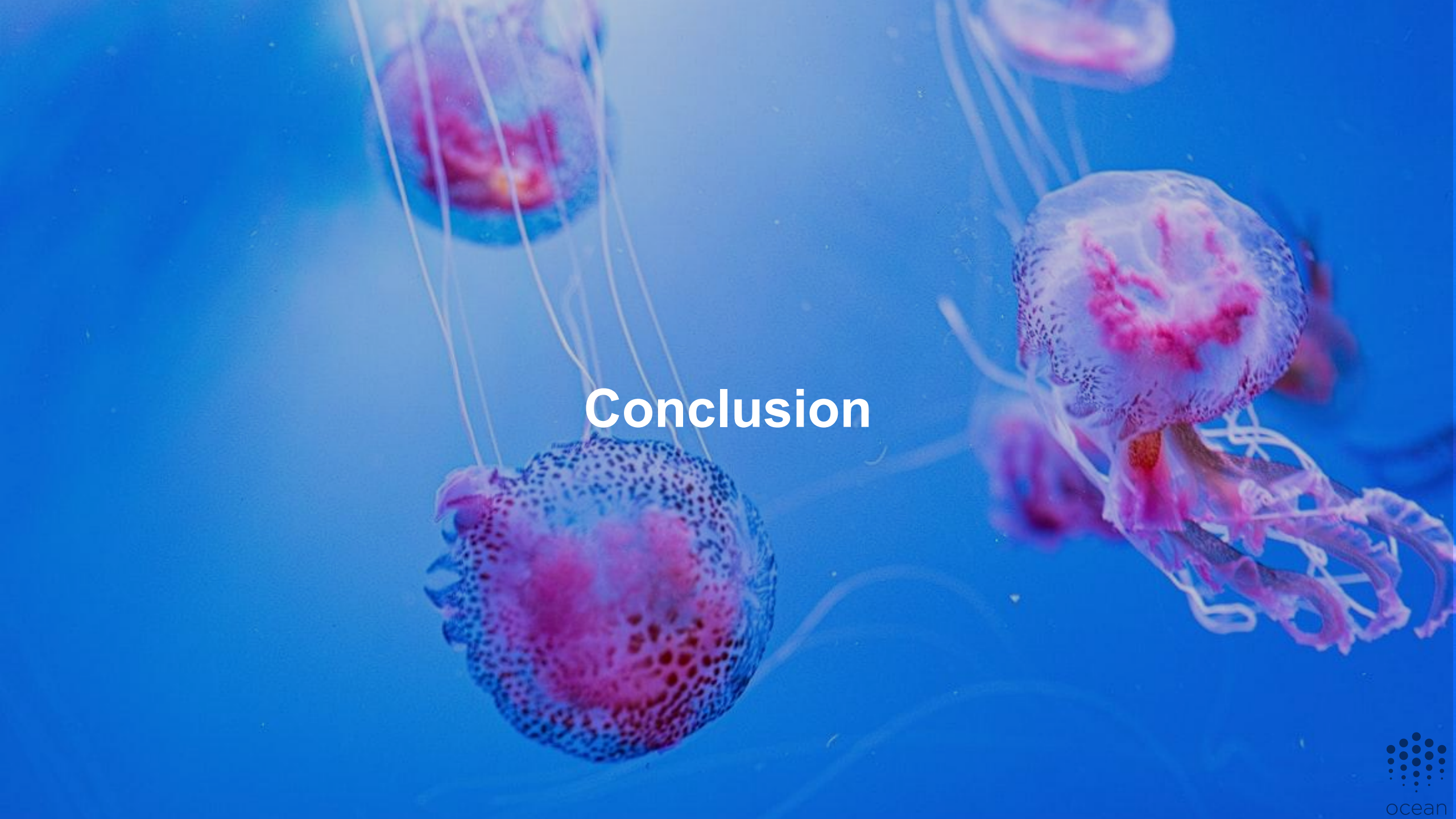
TokenSPICE Quickstart

Let’s walk through **TokenSPICE’s README**

github.com/tokenspice/tokenspice



Conclusion

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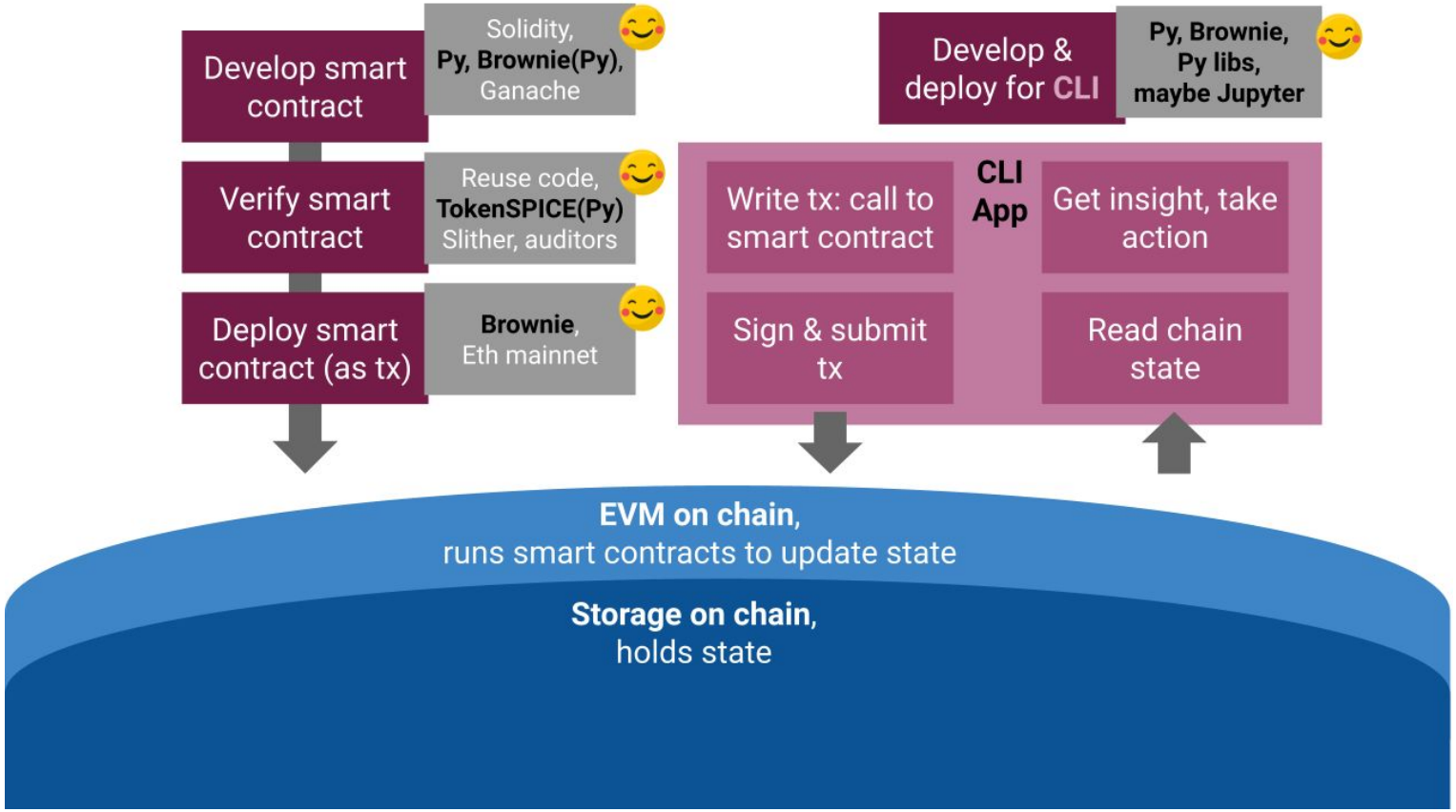
Conclusion

- You know Py + ML, and you want to do cool stuff in blockchain
- Ninja strategy #1: skip Solidity, use ocean.py to tokenize data & algs
- **Ninja strategy #2: dev on Solidity, use Brownie & TokenSPICE**



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@oceanprotocol

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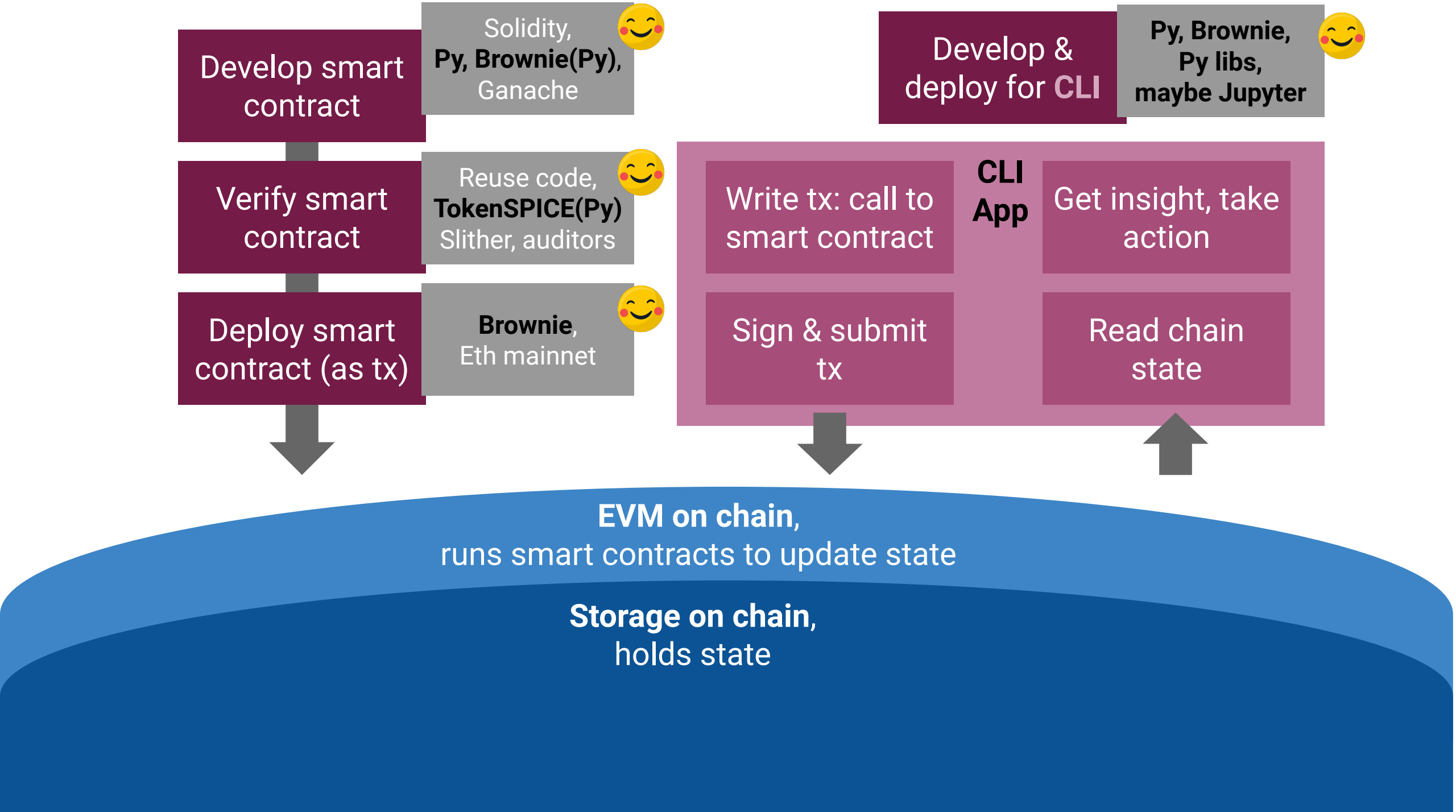
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