Mana

Ethereum client in Elixir

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Acknowledgements

About me

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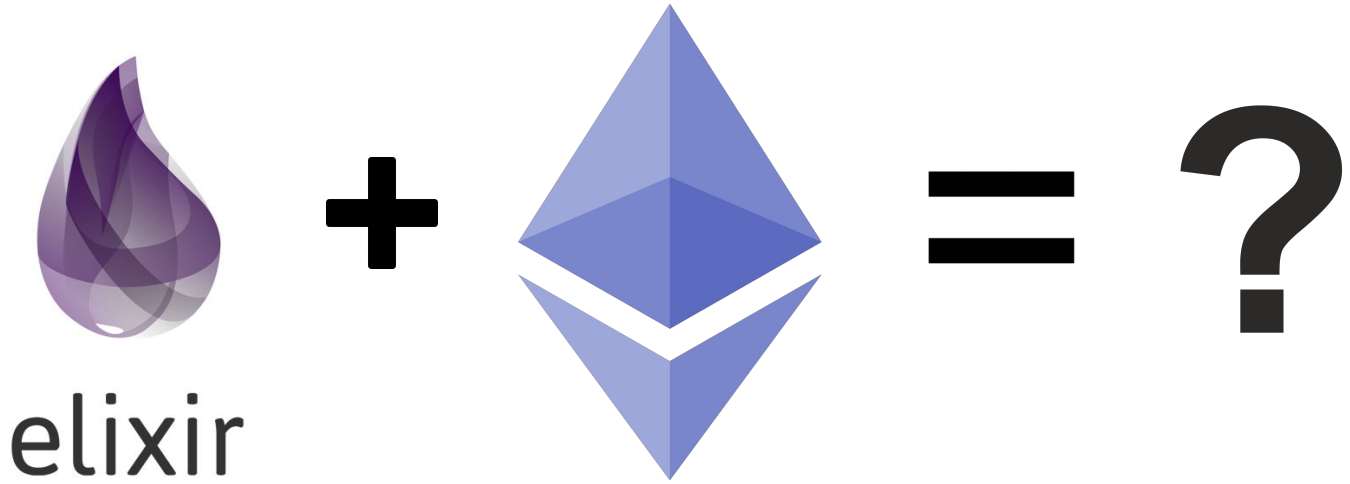
Ethereum

Ethereum clients

- Parity (Rust)
- Geth (Go)
- Pyethereum (Python)

...

Is Elixir suitable for Ethereum?



Consensus algorithms

- Proof of Work
- Proof of Stake
- Proof of Authority

Proof of Work

- hard, useless problem
- a lot of computational power
- a significant amount of energy

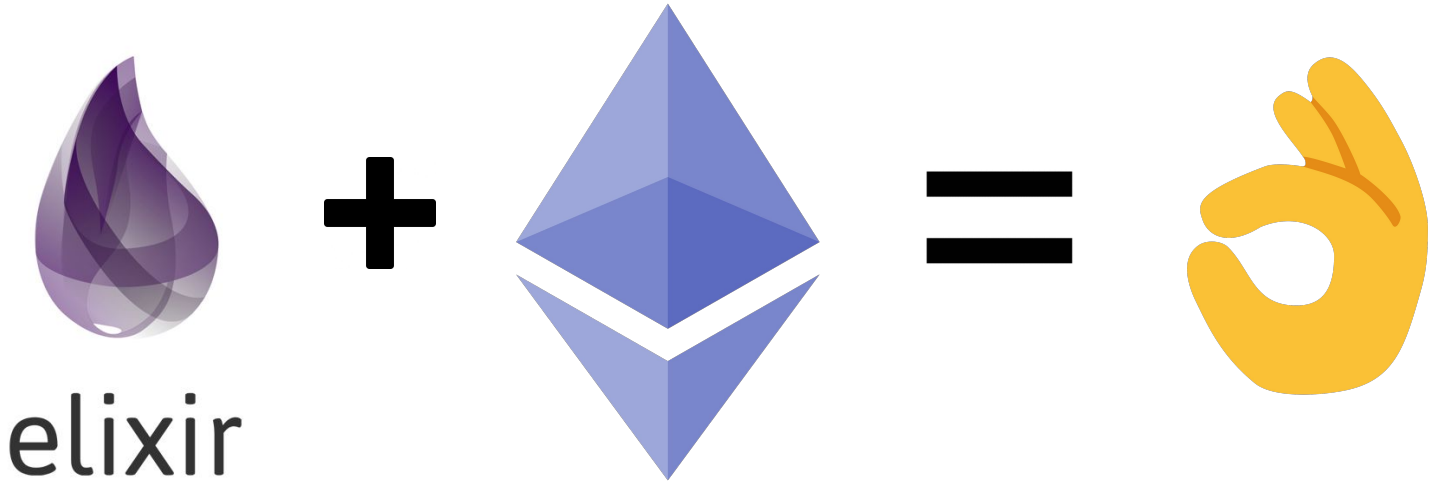
Proof of Stake

- depends on a validator’s economic stake
- number of tokens you own matter
- small numbers of people own the majority of stakes

Proof of Authority

- modification of Proof of Stake
- identity as a stake
- verified personal identities

Is Elixir suitable for Ethereum?



Mana

Project structure

- ExRLP
- MerklePatriciaTree
- EVM
- Blockchain
- ExWire

ExRLP

- Ethereum’s homebrew binary encoding
- simplicity of implementation
- guaranteed absolute byte-perfect consistency

ExRLP - recursive length prefix

```elixir
defprotocol ExRLP.Encode do
  def encode(value, options \\ [])
end

defimpl ExRLP.Encode, for: BitString do
...
end

defimpl ExRLP.Encode, for: Integer do
...
end

defimpl ExRLP.Encode, for: List do
...
end
```

```
iex> [[[]], []] |> ExRLP.Encode.encode
<<195, 193, 192, 192>>

iex> [42, "eth"] |> ExRLP.Encode.encode
<<197, 42, 131, 101, 116, 104>>

iex> [42, ["sun", "moon", 5]] |> ExRLP.Encode.encode
<<204, 42, 202, 131, 115, 117, 110, 132, 109, 111, 111, 110, 5>>
```

ExRLP

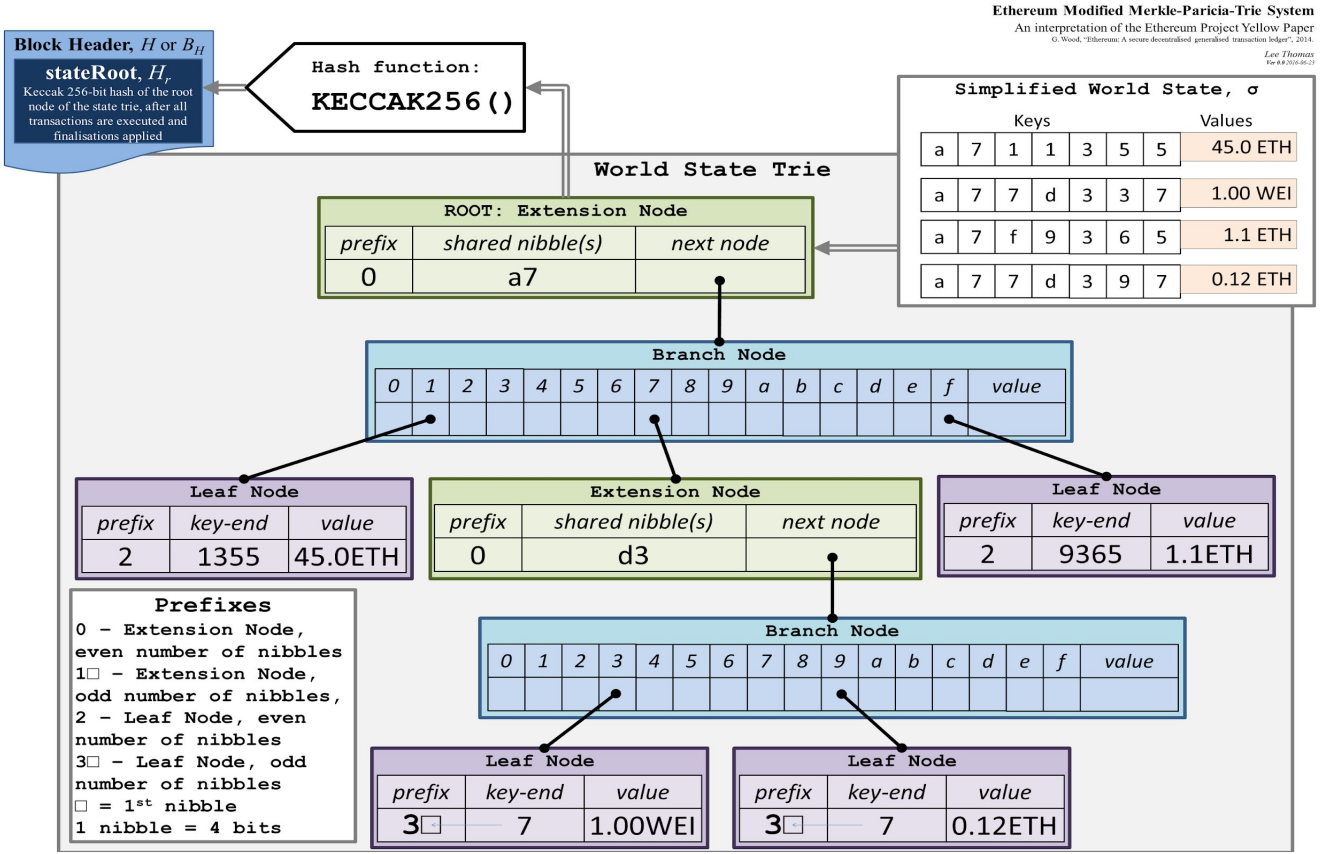
https://www.badykov.com/elixir/2018/05/06/rlp/

https://github.com/exthereum/ex_rlp

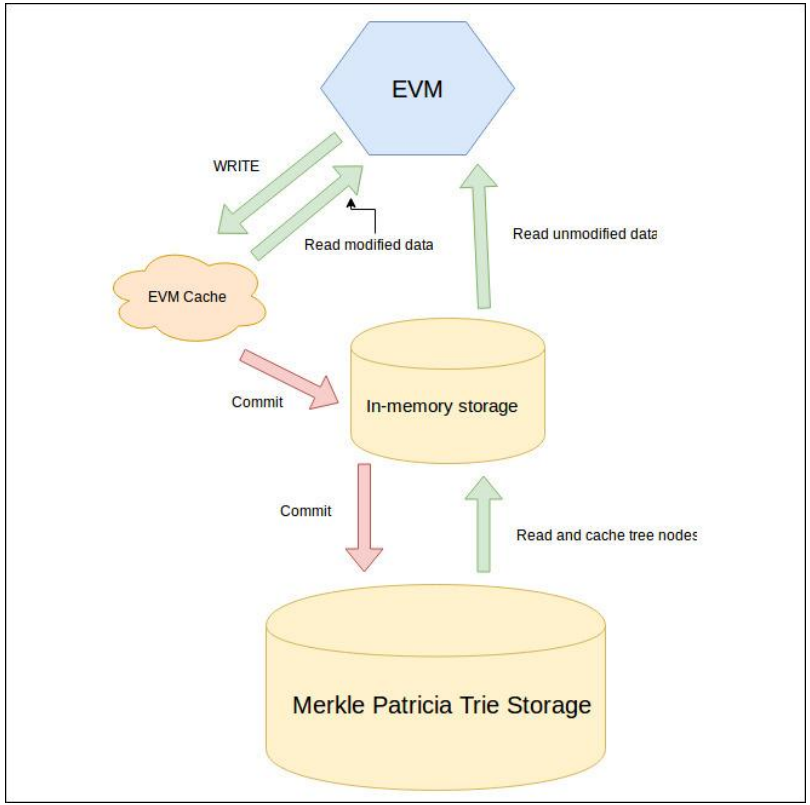
Merkle Patricia Tree (Trie)

- cryptographically authenticated data structure
- Key-value storage
- O(log(n)) efficiency for inserts, lookups and deletes

Merkle Patricia Tree (Trie)



Storage overview



Storage in Ethereum

https://www.badykov.com/ethereum/2018/11/10/storage-in-ethereum/

EVM

- internal state and computation
- executes machine code compiled from Solidity, LLL etc
- stack machine, the stack has a maximum size of 1024

EVM

```
iex> code = <<96, 0, 96, 0, 1, 96, 0, 85>>

iex> code |> EVM.MachineCode.decompile
[:push1, 0, :push1, 0, :add, :push1, 0, :sstore]
```

```
iex> EVM.run(code)
stack:
[]
operation: push1
stack:
[0]
operation: push1
stack:
[0, 0]
operation: add
stack:
[0]
operation: push1
stack:
[0, 0]
operation: sstore
stack:
[]
```

EVM

https://www.badykov.com/elixir/2018/04/29/evm-basics/

Blockchain

The process of finalising a block involves four stages:

(1) Validate (or, if mining, determine) ommers;

(2) validate (or, if mining, determine) transactions;

(3) apply rewards;

(4) verify (or, if mining, compute a valid) state and block nonce

Blockchain hardfork configuration

- Upgrades in Ethereum
- Way to introduce new changes to the chain

Blockchain hardfork configuration

```
defmodule EVM.Configuration do
  @moduledoc """
  Behaviour for hardfork configurations.
  """

  @type t :: struct()

  # EIP2
  @callback contract_creation_cost(t) :: integer()

  # EIP150
  @callback extcodesize_cost(t) :: integer()
```

ExWire

- RLPx
- DevP2P
- Eth Wire

RLPx

- Node Discovery and Network Formation
- Encrypted handshake
- Encrypted transport
- Peer Reputation

DevP2P

- **Hello**
- **Disconnect**
- **Ping**
- **Pong**

Web3 protocols

- Eth
- Whisper
- Swarm

Current state

- Almost passing all Frontier tests
- Hard fork configuration
- Working on Eth protocol sync

Thanks!

https://github.com/poanetwork/mana