ethereum vienna

Workshop
From Contract to DApp

ethereum

Workshops

Workshop #1: Contract Development for Beginners

- Requirements: Basic Understanding of Ethereum
- Solidity Basics

Workshop #2: From Idea to Contract

- Requirements: Basic Understanding of Solidity
- Mapping the real world to ethereum concepts
- Advanced Solidity

Workshop #3: From Contract to DApp

- **Requirements: Basic Understanding of Solidity, HTML/JS, node.js**
- **Interfacing with Ethereum using web3.js**
- **Auxiliary Technologies: IPFS, Whisper and Swarm**

Agenda

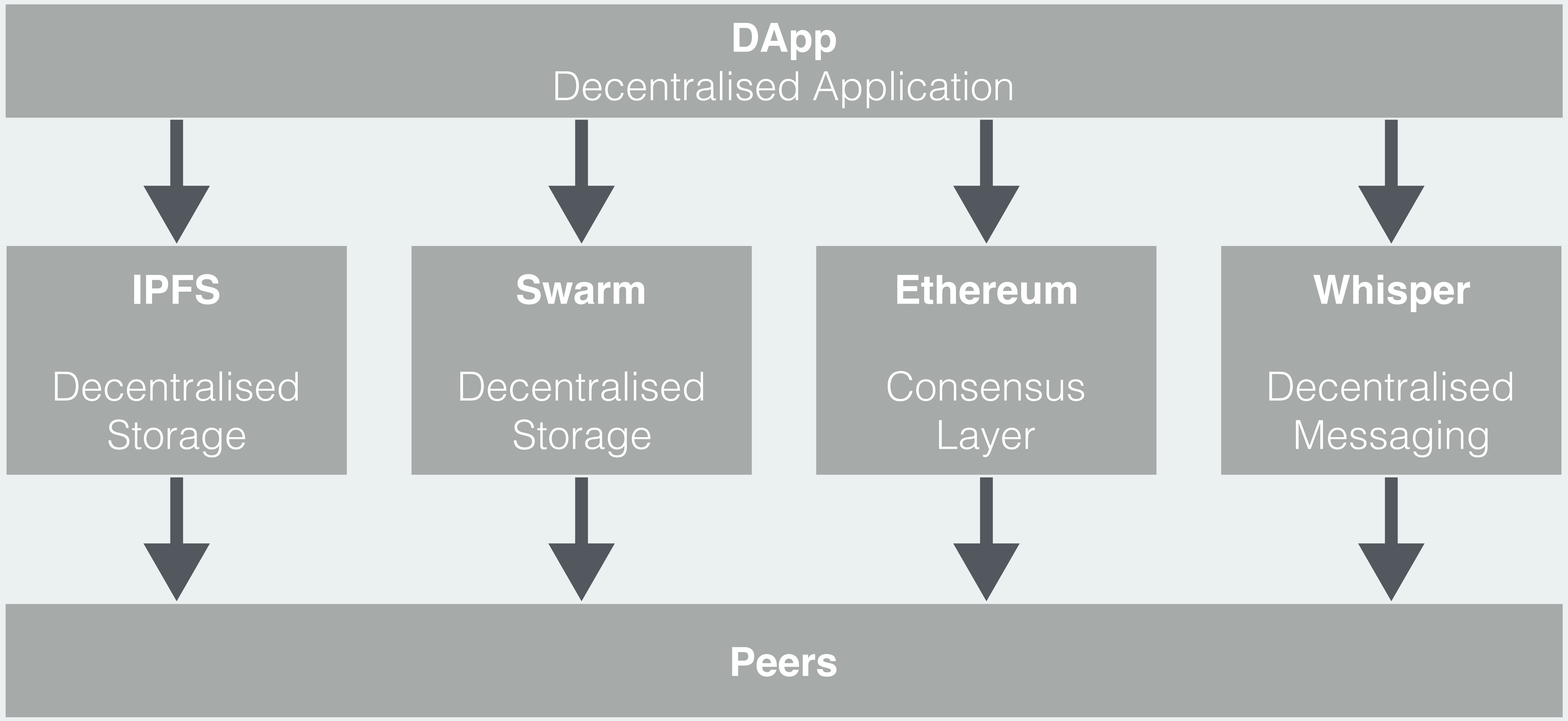
1. Intro to the Ethereum Stack
2. About the workshop
3. The web3.js library
4. **Implementing a simple frontend**
5. Swarm / IPFS
6. **Deploying to IPFS**
7. Standard functionality in DApps
8. Open discussion

Requirements

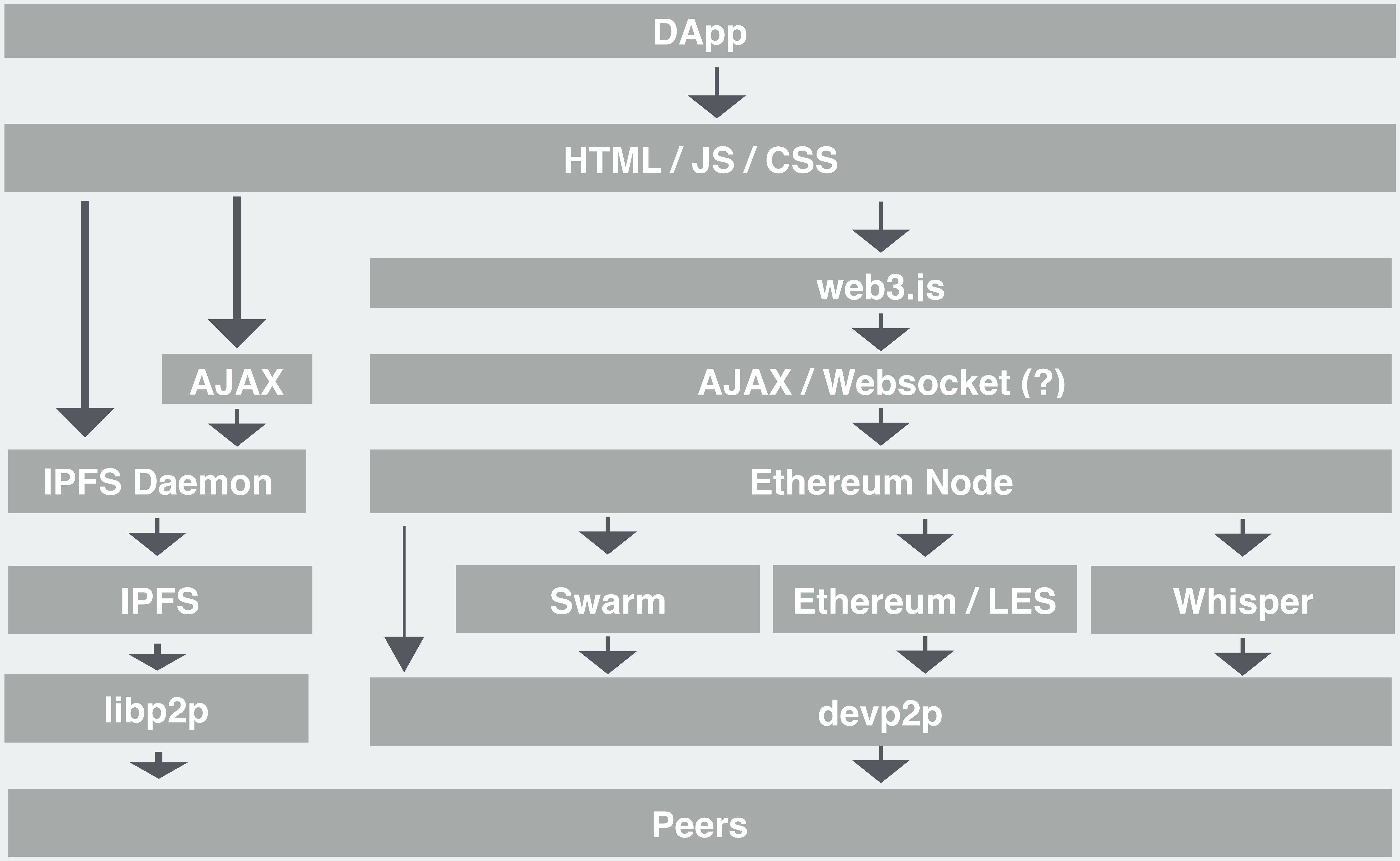
Requirements:

- Knowledge of basic solidity (WS1)
- geth
- Experience with HTML/JS

The Ethereum Stack



The Ethereum Stack



The Ethereum Stack

Is also pretty much the entire stack

using anything else might introduce central points

devp2p not covered not yet directly accessible

In the future everything should be packaged with mist

Ethereum Browser

Mist

Standalone browser for ethereum

Metamask

Browser plugin

both handle account management / unlocking

otherwise accounts need to be manually unlocked (in geth)

About the workshop

No constraints on what you can use

No recommended Framework

Recommendation:

- get web3.js with npm, bundle with webpack
- boilerplate available

geth

start geth with --dev for developer mode

private testchain

use —rpc to enable rpc

set the CORS domain with --rpccorsdomain '*'

also the ipc path —ipcpath /path/to/standard/datadir/geth.ipc to be able to attach other instances

```
geth --dev --rpc --rpccorsdomain '*' --ipcpath /path/to/
standard/datadir/geth.ipc console
```

web3.js

Javascript Bindings for Ethereum

Works with all standard clients

Can connect with

- rpc
- websocket (probably not)

Same library as in geth console

web3.js is great

web3.js sucks

web3.js

currently undergoing massive rework

next major version comes with

- promises
- event emitter

web3.js installation

npm install web3

if used with webpack => json-loader required

require(‘web3’), regardless of used method

web3.js configuration

```
var Web3 = require('web3') /* es6: import Web3 from 'web3' */

/* create a object representing a connection to a node */

var web3 = new Web3()

/* set the provider to the default connection - port 8545 */

web3.setProvider(new Web3.providers.HttpProvider('http://localhost:8545'))

/* ready to use */


/* for reuse as a module */

module.exports = web3 /* es6: export default web3 */
```

web3.js configuration

In Metamask / Mist: web3 already provided. Own web3.js, but keep the provider

```
window.addEventListener('load', function() {
  if (typeof web3 !== 'undefined') {
    web3 = new Web3(web3.currentProvider);
  } else {
    web3 = new Web3(new Web3.providers.HttpProvider("http://localhost:8545"));
  }
  start()
})
```

web3 object structure

consists of several objects

Available in RPC:

web3.eth: interaction with ethereum

web3.shh: interaction with whisper

web3.version: version information about node

web3.net: information about peers

web3 object structure

Not available in RPC:

web3.personal: creating and unlocking accounts

web3.txpool: information about pending transactions

web3.admin: admin interface to geth

web3.miner: mining interface

web3 bignumber

Ethereum deals with huge numbers (2^256-1)

JS Integers to small

=> web3.js uses bignumber.js library

available through **web3.BigNumber**

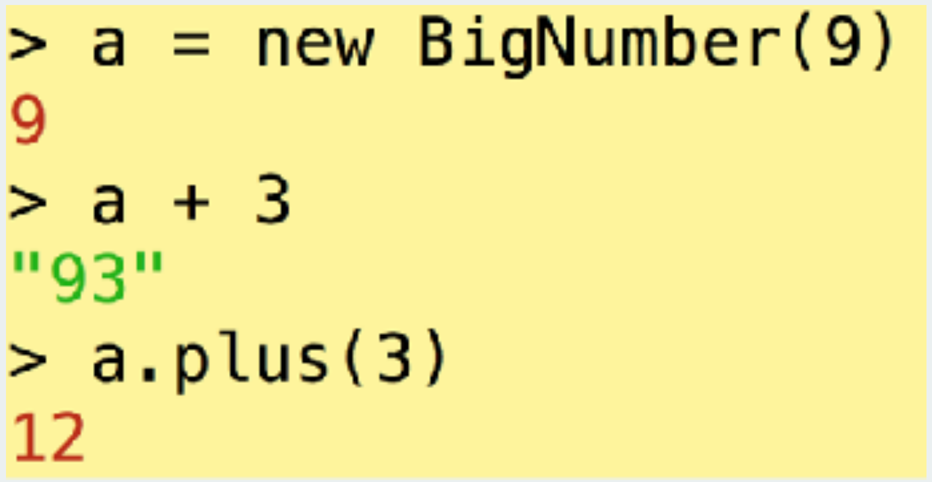
web3 bignumber

var a = new BigNumber(9)

=> { [String: '9'] s: 1, e: 0, c: [9] }

a.toString() == '9'

Use bignumber functions for arithmetic!



```
> a = new BigNumber(9)
9
> a + 3
"93"
> a.plus(3)
12
```

web3 bignumber

conversion utilities available on web3 object

web3.toDecimal

web3.toBigNumber

web3.toHex

and many more

web3 utilities

toUtf8, fromUtf8

toAscii, fromAscii

toWei, fromWei (to convert between ether and wei)

isAddress: check if valid address

isChecksumAddress: check if valid cs address

toCheckSumAddress: converts address to cs address

web3.js sync / async

most calls are synchronous by default

pass a callback as the last argument to make it async

```
eth.getBlock(0)
 => eth.getBlock(0, function (err, block) { /**/ })

eth.accounts
=> eth.getAccounts(function (err, accounts) { /**/ })
```

web3.js sync / async

metamask demands async calls!

only a few selected sync calls allowed:

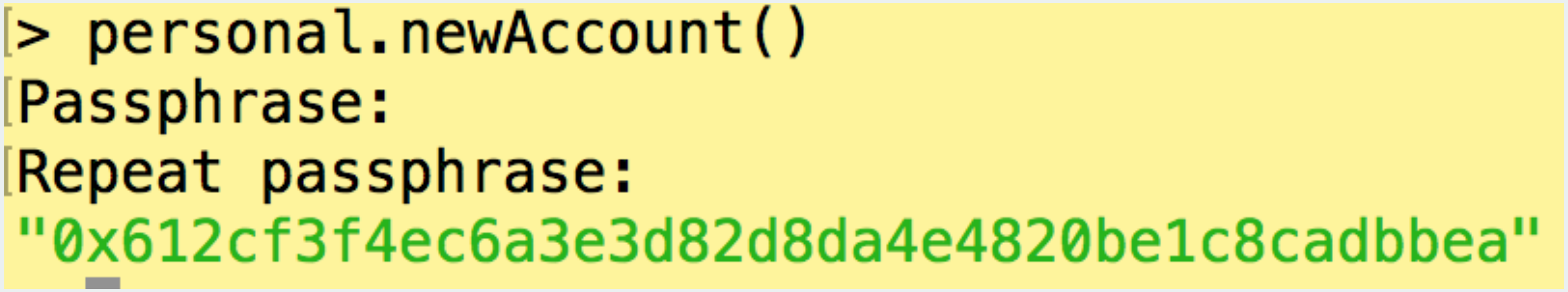
eth.accounts

eth.coinbase

…

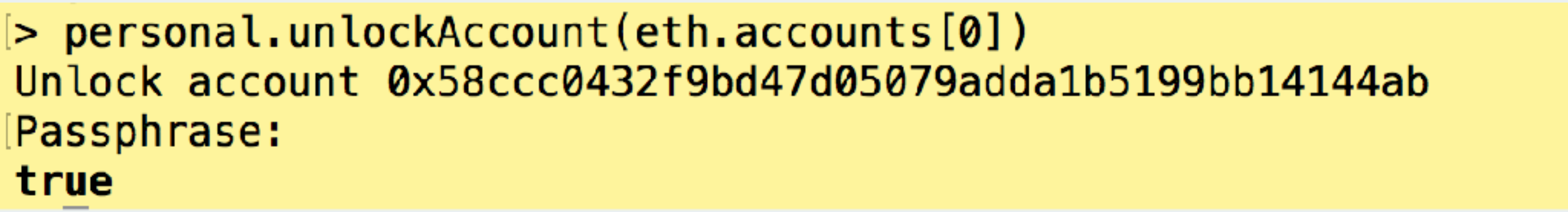
web3.personal

Account creation and unlocking



```
> personal.newAccount()
Passphrase:
Repeat passphrase:
"0x612cf3f4ec6a3e3d82d8da4e4820be1c8cadbbea"
```

Unlocks an account for a certain amount of time



```
> personal.unlockAccount(eth.accounts[0])
Unlock account 0x58ccc0432f9bd47d05079adda1b5199bb14144ab
Passphrase:
true
```

console only. Mist / Metamask use different accounts

web3.eth

accounts

```
> eth.accounts
["0x58ccc0432f9bd47d05079adda1b5199bb14144ab"]
```

getBalance

```
> eth.getBalance(eth.accounts[0])
9.79454623546e+21
```

```
> web3.fromWei(eth.getBalance(eth.accounts[0]))
9859.54623546
```

web3.eth

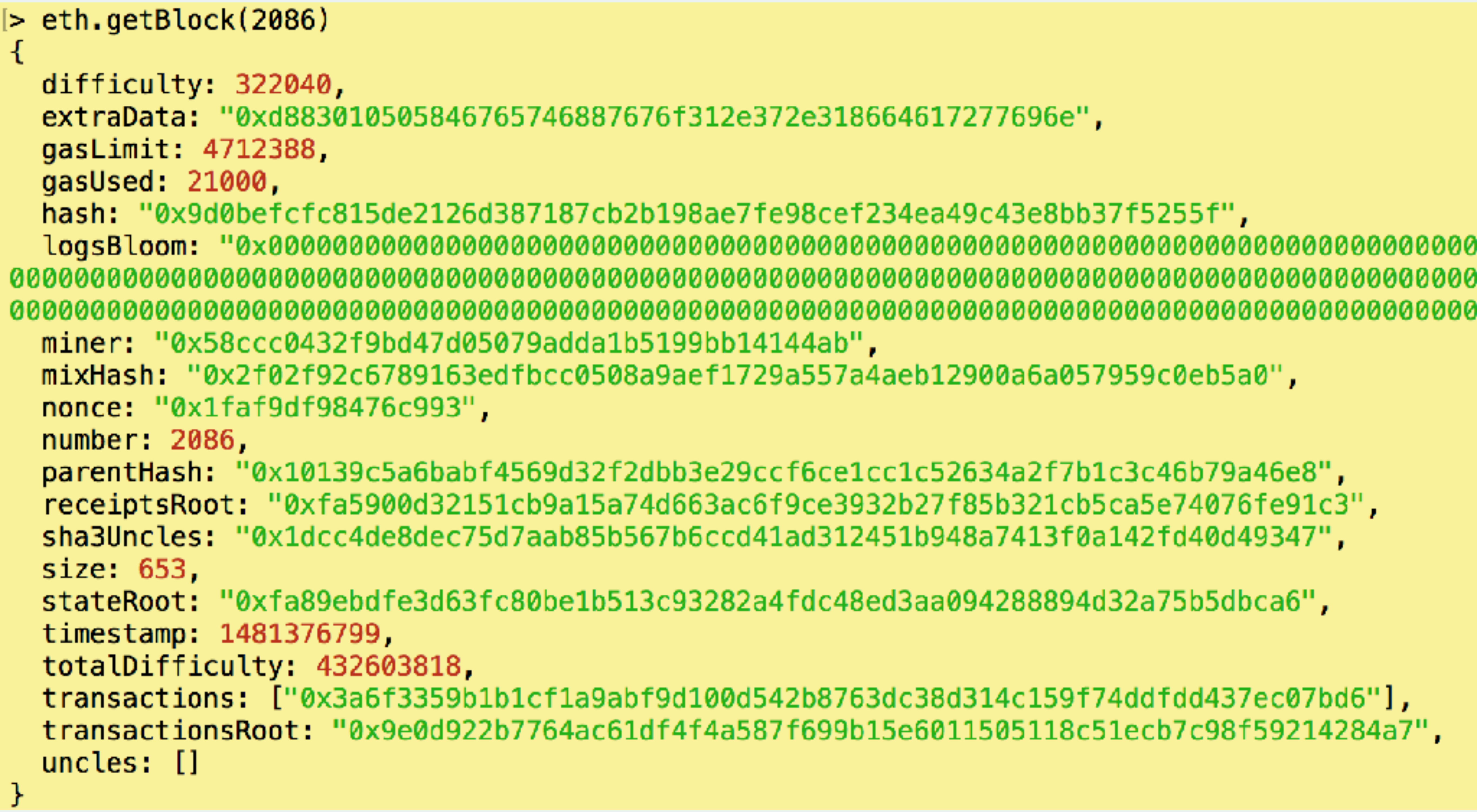
blockNumber

```
> eth.blockNumber
1983
```

For metamask compatibility:

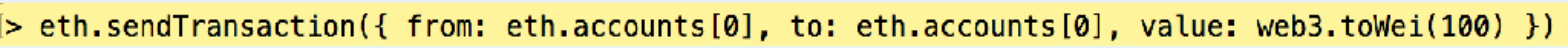
```
> eth.getBlockNumber(function(err, number) { /*  */ })
```

web3.eth



```
> eth.getBlock(2086)
{
  difficulty: 322040,
  extraData: "0xd883010505846765746887676f312e372e318664617277696e",
  gasLimit: 4712388,
  gasUsed: 21000,
  hash: "0x9d0befcfc815de2126d387187cb2b198ae7fe98cef234ea49c43e8bb37f5255f",
  logsBloom: "0x000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
  miner: "0x58ccc0432f9bd47d05079adda1b5199bb14144ab",
  mixHash: "0x2f02f92c6789163edfbcc0508a9aef1729a557a4aeb12900a6a057959c0eb5a0",
  nonce: "0x1faf9df98476c993",
  number: 2086,
  parentHash: "0x10139c5a6babf4569d32f2dbb3e29ccf6ce1cc1c52634a2f7b1c3c46b79a46e8",
  receiptsRoot: "0xfa5900d32151cb9a15a74d663ac6f9ce3932b27f85b321cb5ca5e74076fe91c3",
  sha3Uncles: "0x1dcc4de8dec75d7aab85b567b6ccd41ad312451b948a7413f0a142fd40d49347",
  size: 653,
  stateRoot: "0xfa89ebdfe3d63fc80be1b513c93282a4fdc48ed3aa094288894d32a75b5dbca6",
  timestamp: 1481376799,
  totalDifficulty: 432603818,
  transactions: ["0x3a6f3359b1b1cf1a9abf9d100d542b8763dc38d314c159f74ddfdd437ec07bd6"],
  transactionsRoot: "0x9e0d922b7764ac61df4f4a587f699b15e6011505118c51ecb7c98f59214284a7",
  uncles: []
}
```

web3.eth - sending value



```
> eth.sendTransaction({ from: eth.accounts[0], to: eth.accounts[0], value: web3.toWei(100) })
```

transactionObject has many optional fields:

from: sender (defaults to eth.defaultAccount)

to: destination (can be omitted in contract creation)

value: number of wei to be sent

gas: gaslimit

gasPrice (defaults to eth.gasPrice)

data: function arguments or contract code

web3.eth - sending value

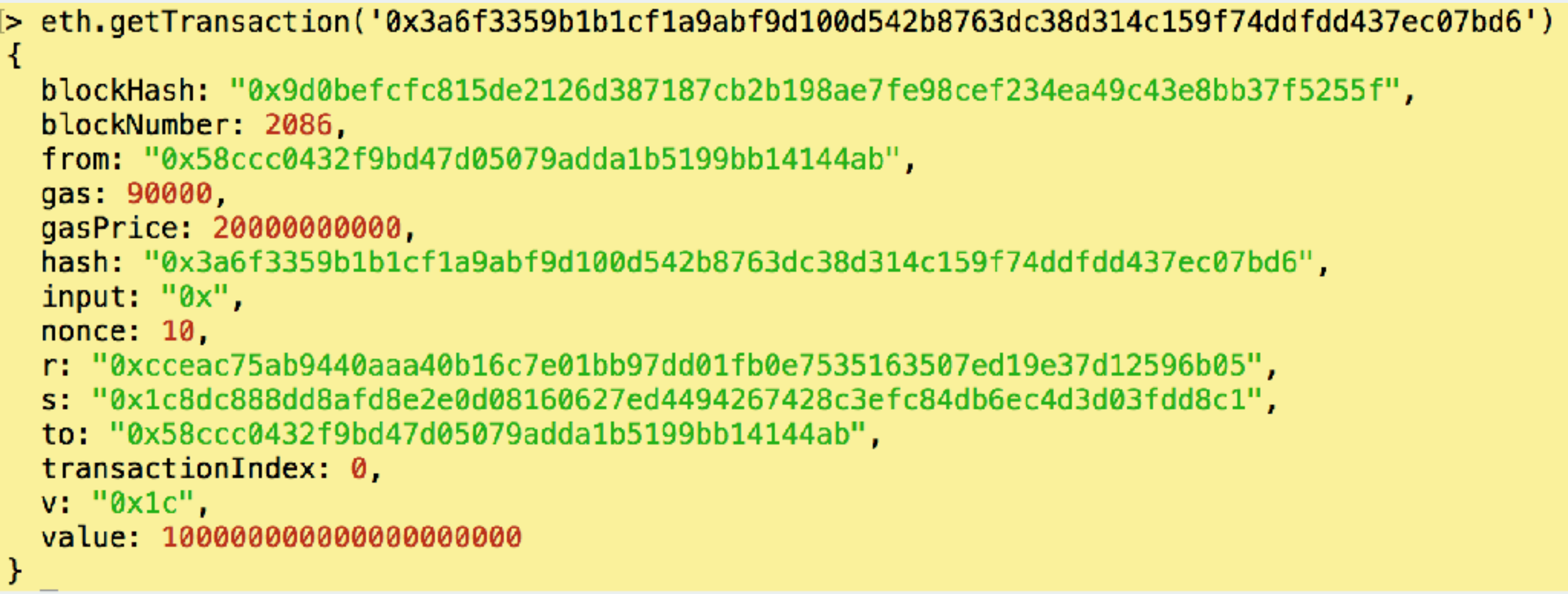
Sending will fails if sender account is not unlocked

In geth manual unlock necessary with

personal.unlockAccount(address)

In Mist / Metamask, there will be a popup

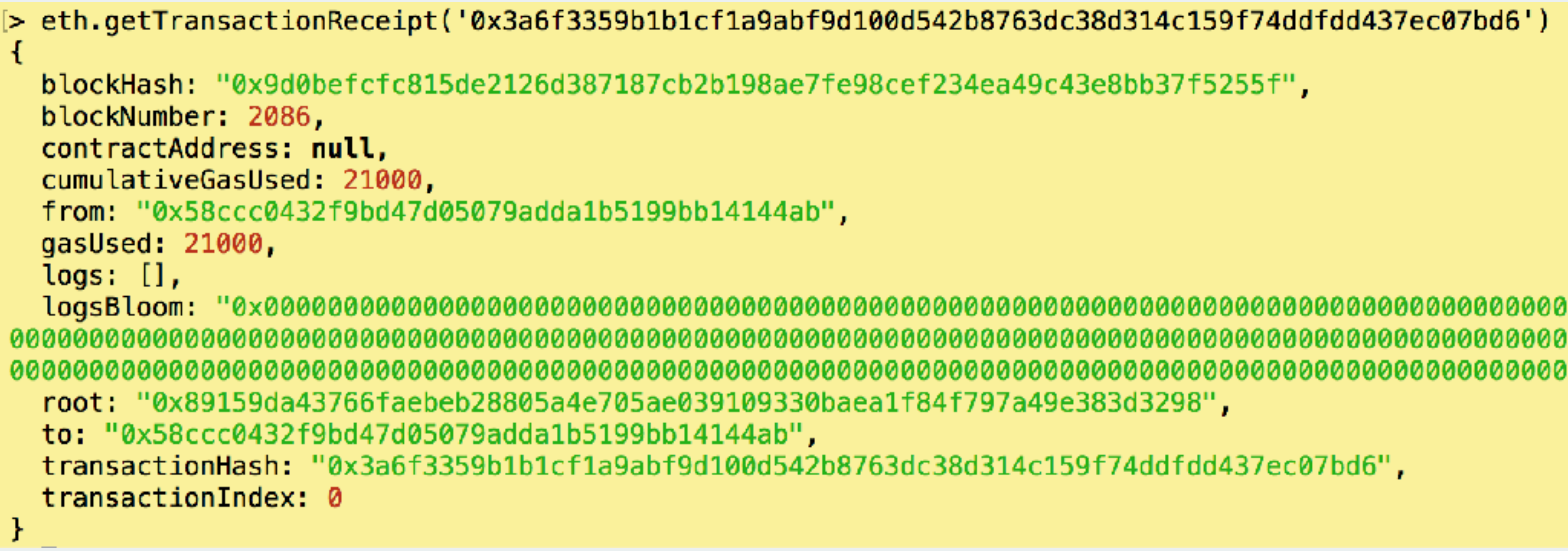
web3.eth



```
> eth.getTransaction('0x3a6f3359b1b1cf1a9abf9d100d542b8763dc38d314c159f74ddfdd437ec07bd6')
{
  blockHash: "0x9d0befcfc815de2126d387187cb2b198ae7fe98cef234ea49c43e8bb37f5255f",
  blockNumber: 2086,
  from: "0x58ccc0432f9bd47d05079adda1b5199bb14144ab",
  gas: 90000,
  gasPrice: 20000000000,
  hash: "0x3a6f3359b1b1cf1a9abf9d100d542b8763dc38d314c159f74ddfdd437ec07bd6",
  input: "0x",
  nonce: 10,
  r: "0xcceac75ab9440aaa40b16c7e01bb97dd01fb0e7535163507ed19e37d12596b05",
  s: "0x1c8dc888dd8afd8e2e0d08160627ed4494267428c3efc84db6ec4d3d03fdd8c1",
  to: "0x58ccc0432f9bd47d05079adda1b5199bb14144ab",
  transactionIndex: 0,
  v: "0x1c",
  value: 100000000000000000000
}
```

blockHash / blockNumber may be null if not yet mined

web3.eth



```
> eth.getTransactionReceipt('0x3a6f3359b1b1cf1a9abf9d100d542b8763dc38d314c159f74ddfdd437ec07bd6')
{
  blockHash: "0x9d0befcfc815de2126d387187cb2b198ae7fe98cef234ea49c43e8bb37f5255f",
  blockNumber: 2086,
  contractAddress: null,
  cumulativeGasUsed: 21000,
  from: "0x58ccc0432f9bd47d05079adda1b5199bb14144ab",
  gasUsed: 21000,
  logs: [],
  logsBloom: "0x0000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
  root: "0x89159da43766faebeb28805a4e705ae039109330baea1f84f797a49e383d3298",
  to: "0x58ccc0432f9bd47d05079adda1b5199bb14144ab",
  transactionHash: "0x3a6f3359b1b1cf1a9abf9d100d542b8763dc38d314c159f74ddfdd437ec07bd6",
  transactionIndex: 0
}
```

returns null if not yet mined

web3.eth

'latest' filter fires for new blocks with their hash

```
> var blockFilter = eth.filter('latest')
```

```
> blockFilter.watch(function(err, blockHash) { })
```

```
> blockFilter.stopWatching()
```

'pending' filter for recent pending transactions

can also be used for events (but there is a better api)

solidity contract abi

JSON description of the interface of a contract

```
[{"constant":false,"inputs":
[{"name":"a","type":"uint256"}],"name":"a","outputs":
[{"name":"b","type":"uint256"}],"payable":false,"type":"function"},
{"inputs":[{"name":"a","type":"uint256"},
{"name":"b","type":"uint256"}],"payable":false,"type":"constructor"}]
```

web3.js can create JS objects that represents contract based on its abi

web3.eth.contract

```
> var Contract = eth.contract(abi)
```

Contract can now be used to create or reference contract instances

To reference an existing contract

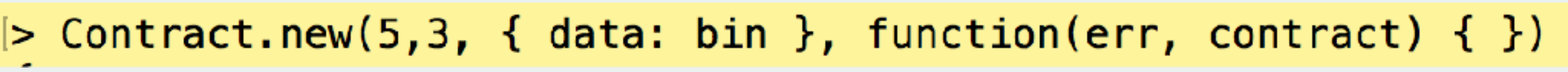
```
> var contract = Contract.at('0x6348ad8c4e02892cf011e222470055f076de1cb0')
```

First come all the constructor arguments

Afterwards the transactionObject (data is mandatory)

web3.eth.contract

To create a new contract:



```
> Contract.new(5,3, { data: bin }, function(err, contract) { })
```

First come all the constructor arguments

Afterwards the transactionObject (data is mandatory)

Callback will fire twice:

Once when transactionHash is know,

then when the transaction is included

solidity contract abi

Calling functions on a contract is simply

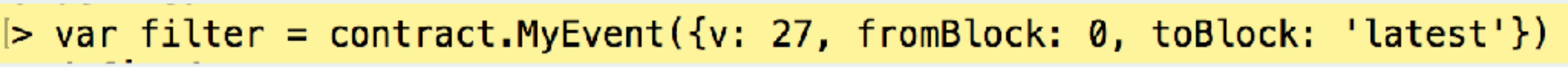
```
contract.functionName(…arguments, txObject, cb)
```

'constant' functions will only be executed locally

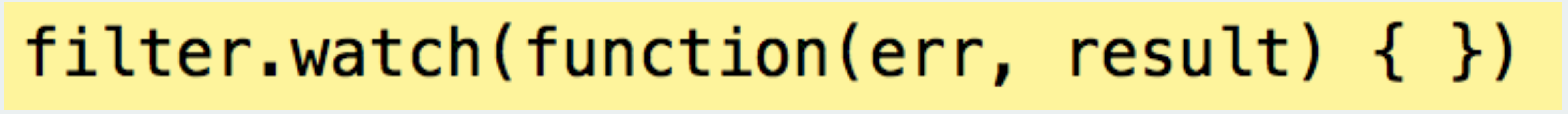
other functions will result in a transaction

solidity contract abi

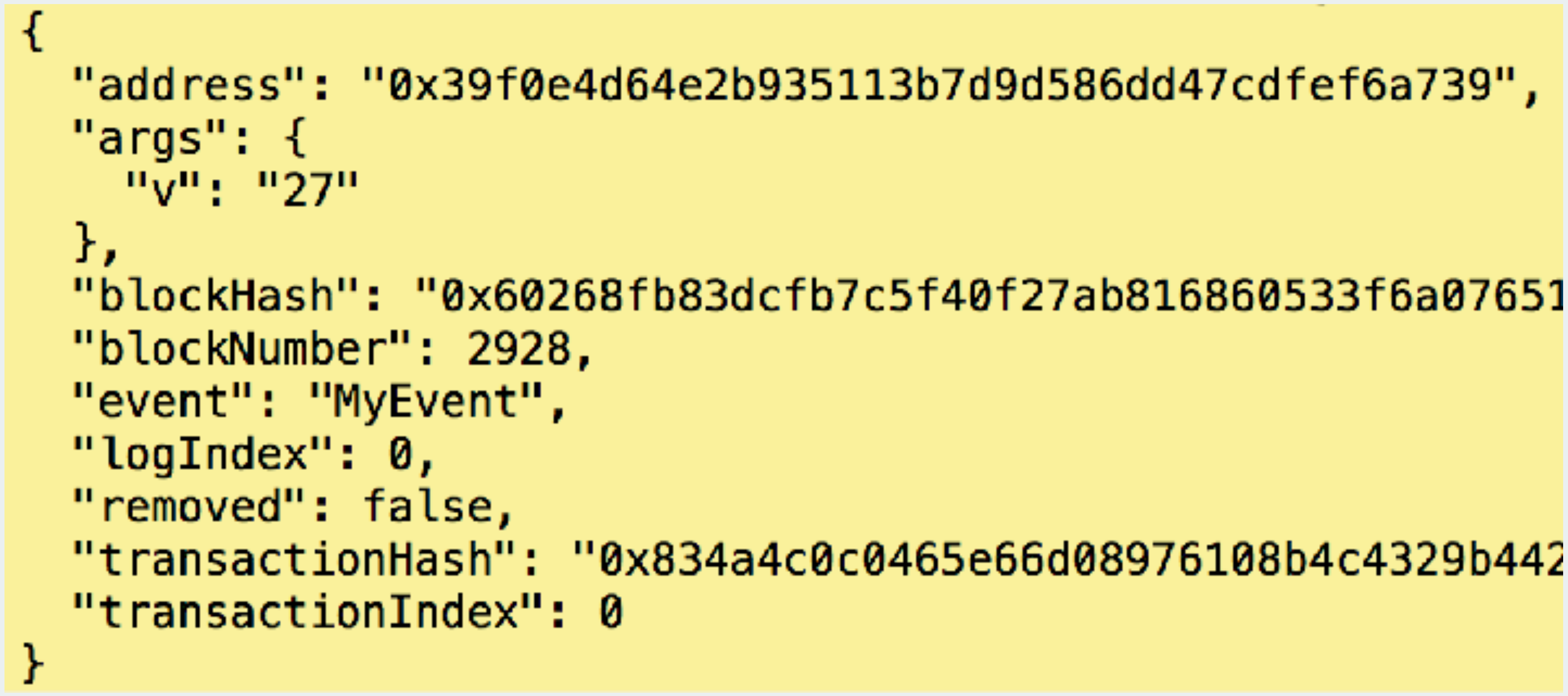
For every event the contract object has a function



```
> var filter = contract.MyEvent({v: 27, fromBlock: 0, toBlock: 'latest'})
```



```
filter.watch(function(err, result) { })
```



```
{
  "address": "0x39f0e4d64e2b935113b7d9d586dd47cdfef6a739",
  "args": {
    "v": "27"
  },
  "blockHash": "0x60268fb83dcfb7c5f40f27ab816860533f6a07651
  "blockNumber": 2928,
  "event": "MyEvent",
  "logIndex": 0,
  "removed": false,
  "transactionHash": "0x834a4c0c0465e66d08976108b4c4329b442
  "transactionIndex": 0
}
```

about reorganisations

Your turn:
Implementing the frontend

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Whisper

Decentralised Messaging

Messages can be filtered by topics

Very flexible

- Messages can be encrypted
- Messages can be signed
- Broadcast

PoW for spam protection and priority

Not designed for real time communication

ethereum

Whisper

Not enabled by default

geth must be launched with --shh

web3.js support through web3.shh

-- dev already implies --ssh

web3.shh

shh.newIdentity: create a new whisper identity

shh.post: send a whisper message

shh.filter: watch for messages

messages can have optional:

from, to, topics

ethereum

Swarm

Swarm (or IPFS)

- Reverse Hash-table
- Originator of source unknown
- Low-latency
- Incentivation model for storage

merged into geth (start with --bzz)

No web3.js support

Intro to IPFS

Decentralised Hash Table

Maps hashes to files

Also support immutable directories (collection of files)

Hash size is not fixed. First bits of the hash indicate hashing algorithm. (so it's no uint256!)

No incentive structure yet (will be developed as a contract)

IPFS from the CLI

ipfs binary from go-ipfs

or jsipfs from the javascript implementation

at least my jsipfs does not connect to anything

add files or directories:

ipfs add -r directory (-r for directories)

to read a file:

ipfs cat HASH

IPFS Gateway

ipfs.io allows browsing hashes without an ipfs node

centralized

like onion.to and such

IPFS from JS

Client library for Javascript

Server can also run in JS but doesn't have to (in dev)

```
var ipfs = window.IpfsApi()
```

```
ipfs.cat
ipfs.files.createAddStream
```

see ipfs-demo.js

Your turn:
Deploy to IPFS

Standard Functionality

In a DApp, much of the functionality of a regular app

must be implemented differently

does not scale as easily

might be less private by default

introduces trusted parties

Standard Functionality

Computationally intensive calculation

Search

Privacy

Spam

1vieCmqYB3DE8StinXYBGGvgJ9hoXP1ib

The End

0x50008dd0cc879e0341042f97541eb4870c9c8393