ethereum vienna

Workshop
Contract Development for Beginners

Agenda

EVM Fundamentals

Mix IDE

Solidity Basics

Fundamentals

Transaction

wraps a message

signed by a private key

only transactions appear in chain

sets gasprice for all contained messages

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Fundamentals

Message

- Sender
- Recipient
- Value (can be 0)
- Data
- Return Value
- Gaslimit

Executes either completely or not at all

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Fundamentals

Contract

- 160 bit address
- Balance
- EVM Bytecode
- Runs at every received message
- Has a persisten 256-to-256 bit storage
  - Private
  - Expensive
- Can spawn new messages

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EVM

Stack machine

256 bit words

Has all the usual instructions plus

block data, tx data, msg data, contract data access

cryptographic functions

message sending

EVM

Storage

- expensive
- persistent

Memory

- cheaper
- byte-level access

Stack

- inaccessible in solidity (except assembly)

EVM

Out of gas exception

Logs

for UIs

Light Clients

Logging

Self Destruct / Suicide

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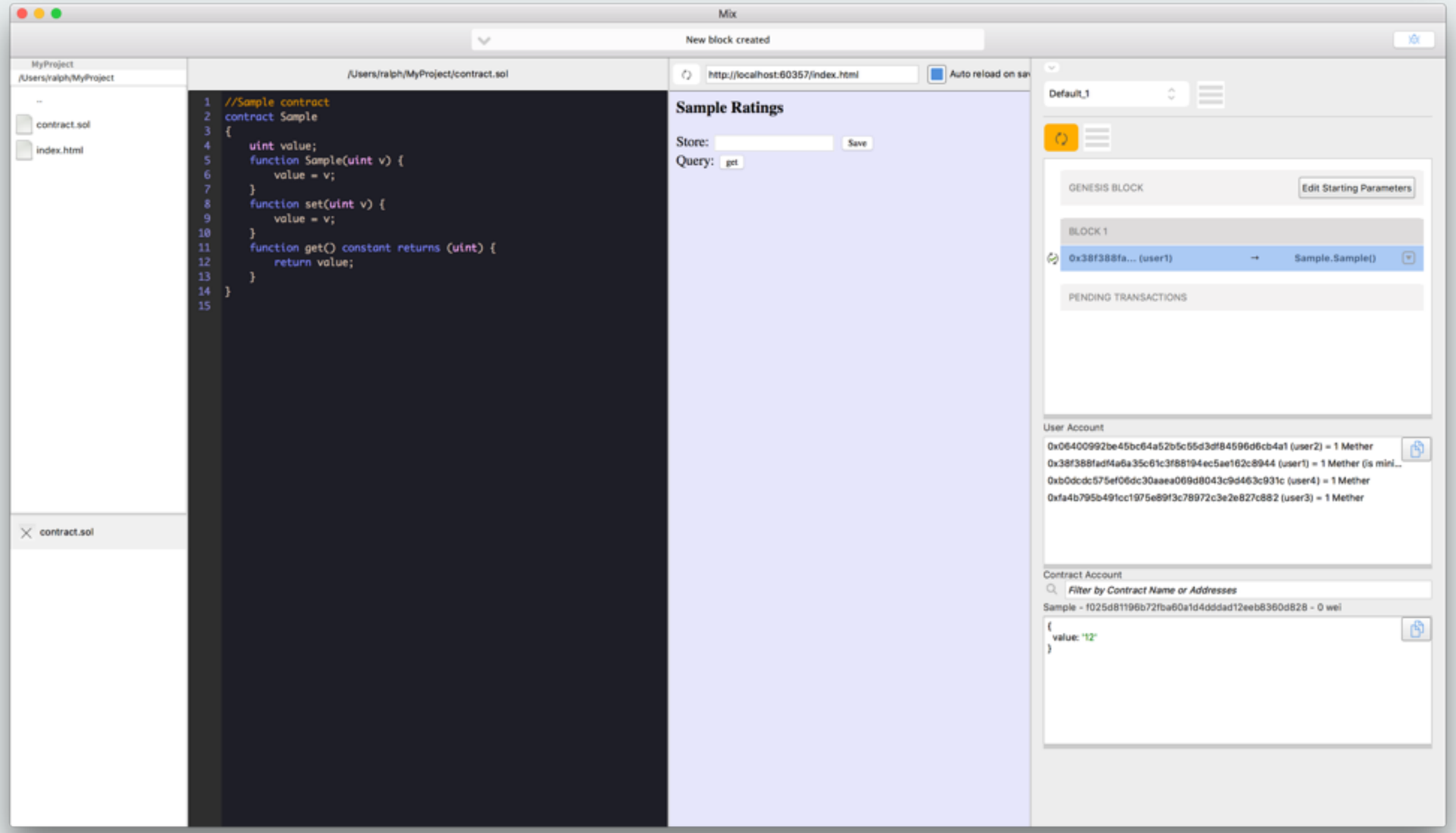
Mix IDE



ethereum Online Compiler

Untitled

```
contract Subscription {

}
```

0xca35b7d915458ef54 Transaction origin

10 ether Value (e.g. .7 ether or 5 wei, defaults to ether)

Subscription 26 bytes

At Address | Create

Bytecode 6060604052600a8060106000396000f3606060405260008565b00

Interface []

Web3 deploy var subscriptionContract = web3.eth.contract([]);

uDApp [{"name":"Subscription","interface":"
[]\n","bytecode":"6060604052600a8060106000396000f3606060405260008565b0

Toggle Details

Solidity Interface: contract Subscription{}

Opcodes: PUSH1 0x60 PUSH1 0x40 MSTORE PUSH1 0xA DUP1 PUSH1 0x10 PUSH1 0x0 CODEC

Functions

Gas Estimates

```
Creation: 39 + 2000
External:
Internal:
```

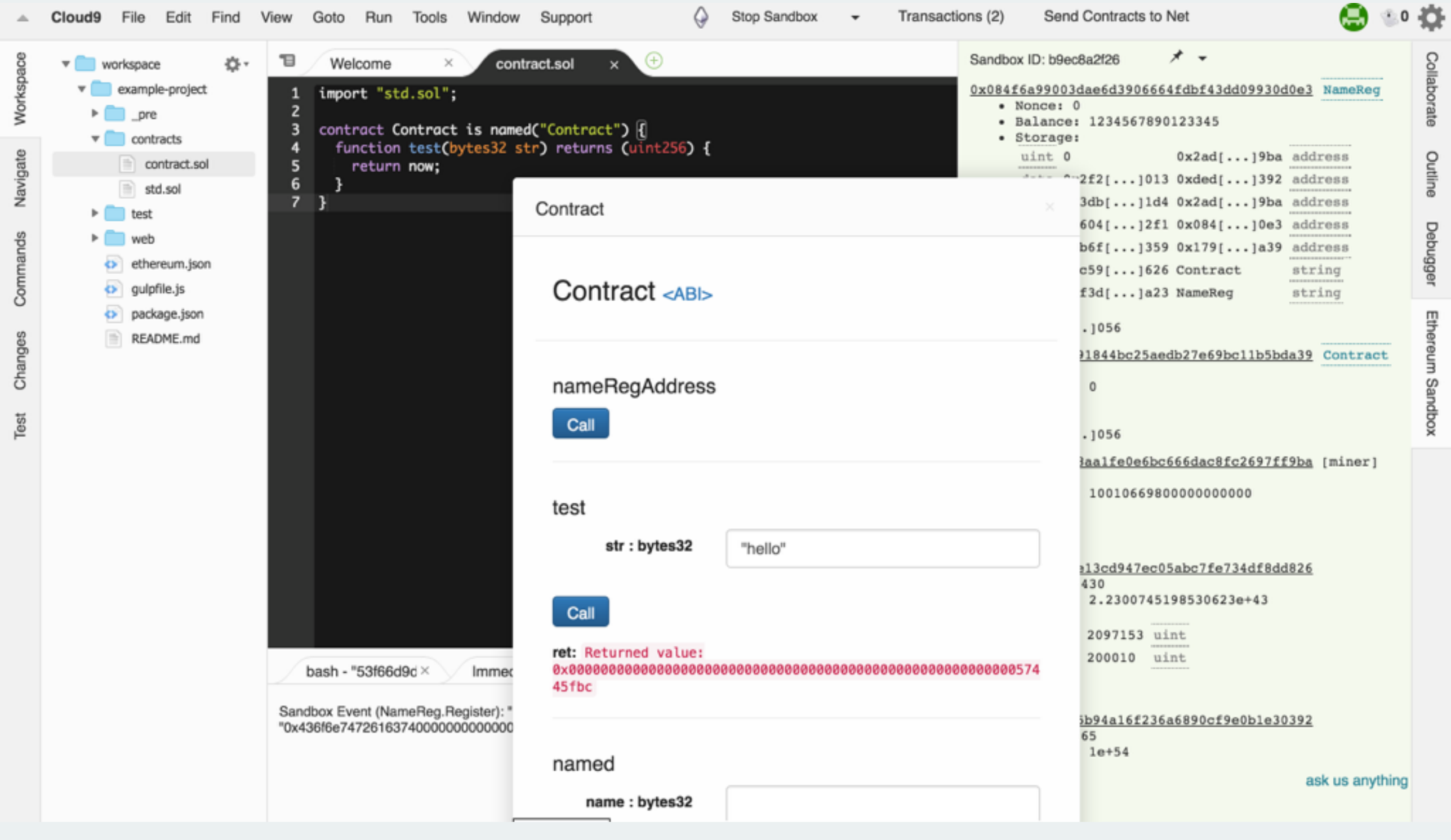
Runtime Bytecode: 6060604052600a8060106000396000f3606060405260008565b00

Assembly

```
.code
  PUSH 60                  contract Subscription {\n
...
  PUSH 40                  contract Subscription {\n
...
  MSTORE                   contract Subscription {\n
...
  PUSH #[$] 0000000000000000000000000000000000000000000000000000000000000000
```

New File

ethereum Ethereum Studio



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Solidity

Developer writes contract with functions

Compiler generates init code and dispatcher

At deployment the contract constructor is executed

```
contract Sample
{
    uint value;
    function Sample(uint v) {
        value = v;
    }
    function set(uint v) {
        value = v;
    }
    function get() constant returns (uint) {
        return value;
    }
}
```

Types

“Standard” types:

Bool

Int: Signed 256 bit Integer (other sizes available)

UInt: Unsigned 256 bit Integer (other sizes available)

Array: Static and Dynamic

String

Enum

ethereum Types

Special types:

- Address: 160 bit for ethereum address
  - Fields: balance
  - Functions: send, call, callcode, delegatecall
- Mapping (hashtable-like):
  - maps from one solidity type to another
  - contains all keys at construction
- Contract Types:
  - Inherits from address
  - Have contract-specific functions

```
contract Sample
{
    address a = 0x1239028420398492304f23947289deee24839589;
    mapping (address => uint) balances;
    Sample otherContract;
}
```

Control Flow

If

```
function hello (uint x) returns (uint) {
    if (x > 5) {
        return 9;
    } else {
        return 10;
    }
}
```

ethereum Control Flow

For

```
for(uint a = 0; a < 99; a++) {

}
```

While / Break

```
while(true) {
    break;
}
```

Other

this.balance: gets the balance of the contract

this.function(): calls a function by transaction

super: inheritance

Automatic getter generation, declare a variable as public

Special variables for blockchain interaction

Global Vars

msg.

- sender
- value
- gas

tx.

- origin
- gasprice

Global Vars

block.

- coinbase
- difficulty
- timestamp
- blockhash
- number

Special cryptographic functions (e.g. sha3)

Events for writing to the log

```
Funder[] public funders;
event FundTransfer(address backer, uint amount, bool isContribution);
```

Import

Standard contracts

Contract inheritance

- Code from ancestor copied into child
- Still only one contract

Exercise #1

Trusted data feed

Contains only one field

Can only be changed by the creator

Change Event

Field can be read by other contracts

relevant globals: msg.sender

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Modifier

Modifiers for code reuse

```
modifier afterDeadline() { if (now >= deadline) _ }

/* checks if the goal or time limit has been reached and e
function checkGoalReached() afterDeadline {
    if (amountRaised >= fundingGoal){
        // sends amountRaised wei to beneficiary account
        beneficiary.send(amountRaised);
        FundTransfer(beneficiary, amountRaised, false);
```

ethereum Exceptions

throw: creates and exception

execution aborts, state reverts

cannot be caught on contract functions

all gas is used

```
var offer = offers[id];
/* throw if offer is not taken */
if(offer.status != Status.TAKEN) throw;
/* throw if sender is not the taker */
if(msg.sender != offer.taker) throw;
```

Sending Ether

Every address or contract object

has a send method, takes the amount in wei

```
address recipient = 0x1223;
uint amount = 50 ether;
recipient.send(amount);
```

Exercise #1.5

Trusted data feed

Contains only one field

Can only be changed by the creator

Change Event

Field can be read by other contracts **(for a fee)**

relevant globals: msg.value, throw

Exercise #2

Subscription Contract

Manages **one** subscription

Recipient: can withdraw PRICE wei per TIME

Creator: can cancel if there are not outstanding payments

relevant:

address.send(value): send value wei to address

block.timestamp: unix timestamp (in seconds)

ethereum Contract Calls

Coerce address into contract type

Call the function on that

.value() to send wei

.gas() to limit gas

```
    uint public fundingGoal; uint
    token public tokenReward;
    Funder[] public funders;
```

```
// Coerce an address into a contract type
tokenReward = token(_reward);
```

```
// sends a sendCoin message to the tokenReward contract
tokenReward.sendCoin(msg.sender, amount / price);
```

```
// sends a sendCoin message to the tokenReward contract
tokenReward.sendCoin.value(10 ether)(msg.sender, amount / price);
```

Structs

```
/* data structure to hold information about campaign contributors */
struct Funder {
    address addr;
    uint amount;
}
```

```
n(Funder({addr: msg.sender, amount: amount}))
```

```
funder.addr.send(funders[i].amount);
FundTransfer(funder.addr, funder.amount, false);
```

Arrays

```
Funder[] public funders;
```

push: adds a new element to the array

```
// push an additional value onto the array
funders.push(Funder({addr: msg.sender, amount: amount}));
```

```
var funder = funders[i];
```

ethereum Solidity

functions can have multiple return values

retrieve values by deconstruction

Visibility

External

Can only be called by a message

Public

Can be called by anyone

Private

Can only be called by the contract itself

Internal

Cannot be called by a message

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Enums

```
/* Status enum for the 3 possible states */
enum Status { OFFERED, TAKEN, CONFIRMED}
```

```
/* throw if the offer has already been taken
if(offer.status != Status.OFFERED) throw;
```

Exercise #3

Market Contract

Seller can add offers (with name and price)

Buyer can take offers (by sending the right amount)

Buyer can confirm the offer (and release funds)