

스마트 컨트랙트 활용 실습

1. 실습 준비

- 1) 스마트 컨트랙트
- 2) 하이퍼렛저 베수 구동
- 3) Remix 활용
- 4) Web3 사용

2. 토큰 발행 실습

- 1) 토큰 발행 실습

3. 지갑 만들기

- 1) 지갑 만들기 실습

변수 / 데이터 타입

데이터 타입	키워드	사용	범위
Boolean	bool	True or False	True/ false
Uint	uint8	부호가 없는 정수 표현	0~255
	uint16		0~65535
	uint24		0~16777216
	uint256		0~
	uint		0~
String	string	문자열	-
Address	address	주소 잔액 조회	-
	address payable	주소 이더 전송	-
Array	DataType []	배열 선언 <ul style="list-style-type: none"> push: 가장 마지막 데이터 추가 pop: 가장 마지막의 데이터를 가져오고 제거 length: 배열의 길이 struct: 구조체 선언 	-
Map	Mapping (key type => value type)	맵	-

함수 및 옵션

```
function 함수 이름 () 옵션 {
    기능 정의
}
```

```
function tempFunction() view{
}

function tempFunction2() pure{
}
```

옵션

- view/pure를 사용하여 데이터 조회시 수수료를 지불하지 않음
- view는 변수값을 조회하여 반환 가능하나, pure는 변수에 접근 불가능
- view/pure가 붙은 함수는 데이터 변경이 불가능

View	Pure
<ul style="list-style-type: none"> • 상태 변수 값 변경 • 이벤트 발생 • 다른 계약 생성 • selfdestruct 사용 (해당 계약 계정을 삭제하고 모든 잔액을 지정된 주소로 이동) • 이더 전송 • view 혹은 pure로 선언되지 않은 어떠한 함수라도 호출 •로우 레벨 호출 • 특정 OPCODE를 포함한 인라인 어셈블리 사용 	<ul style="list-style-type: none"> • 상태 변수 읽기 • this.balance 혹은 <주소>.balance 접근 • Block, tx, msg중 하나의 멤버 변수에 접근 (msg.sig와 msg.data) 제외 • Pure로 정의되어 있지 않은 어떠한 함수라도 호출 • 특정 OPCODE를 포함한 인라인 어셈블리 사용

함수의 호출 범위 (가시성)

- Public: 모든 영역 (상속 받은 컨트랙트, 외부 컨트랙트, 내부)에서 함수 호출 가능
- Private: 해당 함수를 포함한 컨트랙트 내부에서만 호출 가능
- External: 다른 컨트랙트에서 호출하거나 트랜잭션으로만 호출 가능
- Internal: private와 비슷하지만 internal은 상속받은 컨트랙트에서도 호출 가능

```
function tempFunction() public view returns (uint256) {  
    }  
  
function tempFunction2() private pure returns (string) {  
    }
```

```
function tempFunction() public view returns (uint256) {  
    }  
function tempFunction2() private pure returns (string) {  
    }
```

```
function 함수 이름 () 호출범위 옵션 return (return 데이터 타입) {  
    기능 정의  
}
```

생성자

```
1 pragma solidity >=0.4.22 <0.6.0;  
2  
3 contract mung{  
4     uint vall;  
5     address owner;  
6     constructor(uint _v) public{  
7         vall = _v;  
8         owner = msg.sender;  
9     }  
10 }
```

- constructor 키워드를 사용
- 함수와 동일한 방법으로 사용
- 스마트 컨트랙트를 배포할 때 가장 처음 호출되는 함수
- Return 키워드 사용 불가

payable

```
1  pragma solidity >=0.4.22 <0.6.0;  
2  
3  contract mung{  
4  
5      function() external payable{  
6          address sender = msg.sender;  
7          uint value = msg.value;  
8      }  
9  
10 }  
11
```

- 외부로부터 이더를 받았을 때 호출하도록 하는 키워드
- Payable이 붙어 있으면 이더를 받았을 때 호출하라는 의미가 있음
- payable이 붙은 경우 함수는 external이어야함
- msg.sender = 함수를 호출한 지갑 주소를 가져옴
- msg.value = 전송된 이더량

함수 변경자

```
1  pragma solidity >=0.4.22 <0.6.0;
2
3  contract mung{
4
5      address owner;
6
7      constructor() public {
8          owner = msg.sender;
9      }
10
11     modifier ownerCheck(){
12         require (msg.sender == owner);
13         _;
14     }
15
16     function getData() public view ownerCheck() returns (uint){
17         return 10;
18     }
19
20 }
```

- 함수변경자는 스마트 컨트랙트를 실행할 때 미리 실행되는 함수
- modifier 키워드 사용
- 예를들어 특정 지갑 주소만 함수를 호출할 수 있도록 설정 할때 사용

예외 처리

- require, assert를 이용

이벤트

- event 키워드를 사용
- 스마트 컨트랙트에서 특정한 일이 발생했을 때 외부에 알려주는 역할

address 타입의 자료형

- Address 타입의 자료형은 balance와 transfer 사용가능
- Balance는 특정 지갑 주소의 이더 보유량을 조회
- Transfer는 스마트 컨트랙트가 보유중인 이더를 다른 지갑 주소로 전송 가능

조건문, 반복문

- 조건문 : if, if else, else
- 반복문: for

상속

- is 키워드 사용
- public, internal 일때 사용 가능

하이퍼렛저 베수 구동

privateNetwork > besu_network

이름

- networkFiles
- node1
- node2
- node3
- node4
- command.txt
- genesis.json
- genesis_creator.json



하이퍼렛저 벡수 구동

[illegible][illegible][illegible]

```

MINGW64/E:/besu_privateNetwork/besu_network/node4
C:\Windows\system32\cmd.exe /c schTASK -create /F "/E:" "Schedule created with milestones: [MuirGlacier: 0]"
2022-03-06 12:22:49.568:09:00 main INFO RunnerBuilder | Detecting NAT service.
2022-03-06 12:22:49.702:09:00 main INFO Runner | Starting external service.
2022-03-06 12:22:49.705:09:00 main INFO WebsocketService | Starting Websocket service on 127.0.0.1:8548
2022-03-06 12:22:50.477:09:00 main INFO HttpEventLoopThread-1 | INFO | WebsocketService | WebsocketService started and listening on 127.0.0.1:8548
2022-03-06 12:22:50.470:09:00 main INFO AutoTransaction Bloom cachingService | Starting auto transaction bloom caching service.
2022-03-06 12:22:50.470:09:00 main INFO BlockchainMetadata | Lookup cache metadata file in data directory: E:\besu_privateNetwork\besu_network\node4\data\cache
2022-03-06 12:22:50.484:09:00 main INFO Runner | Starting Ethereum main loop ...
2022-03-06 12:22:50.484:09:00 main INFO NatService | No NAT environment detected so no service could be started
2022-03-06 12:22:50.485:09:00 main INFO NetworkGroup-1 | Starting Network.
2022-03-06 12:22:50.491:09:00 main INFO nioEventLoop-2-1 | INFO | RlpXAgent | P2P discovery agent on port=30303
2022-03-06 12:22:50.492:09:00 main INFO PeerDiscoveryAgent | Starting peer discovery agent on host=0.0.0.0, port=30306
```

[illegible]

```

MINGW64/e:/besu_privateNetwork/besu_network/node3
controllerBuilder | Imported #854 / 0 tx / 0 pending / 0 (0.0%) gas / (0x4ee72cfcb
b677a2f228a65c26b9b8d8f9454781e39c6af4d345d23bbca533)
2022-03-06 12:22:57.253+0000 | BFTProcessorExecutor-IBFT-0 | INFO | IbfTBSuCo
b677a2f228a65c26b9b8d8f9454781e39c6af4d345d23bbca533
2022-03-06 12:22:57.253+0000 | BFTProcessorExecutor-IBFT-0 | INFO | gas / (0xb1370b6dc
901d3cf789b99c0ebc3d3bf6be15f33b215f3731434)
2022-03-06 12:22:59.169+0000 | BFTProcessorExecutor-IBFT-0 | INFO | IbfTBSuCo
controllerBuilder | Produced #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f39a
7ac83b948e6b9b676e57101cf89d6f454123dbdb61c2ff0a33bf37)
2022-03-06 12:23:01.257+0000 | BFTProcessorExecutor-IBFT-0 | INFO | IbfTBSuCo
controllerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
2022-03-06 12:23:01.257+0000 | BFTProcessorExecutor-IBFT-0 | INFO | gas / (0x7206b5357
2022-03-06 12:23:03.113+0000 | BFTProcessorExecutor-IBFT-0 | INFO | IbfTBSuCo
controllerBuilder | Imported #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7f728c371
814787b1309d2a3105f974f37c0419604bfc3d2c0629191eada84d)
2022-03-06 12:23:05.146+0000 | BFTProcessorExecutor-IBFT-0 | INFO | IbfTBSuCo
controllerBuilder | Imported #859 / 0 tx / 0 pending / 0 (0.0%) gas / (0xca7a8d320
b71daa414314b014af25e07e0e52542f8e9d01612982a74488b1)
2022-03-06 12:23:05.155+0000 | EtlScheduler-Workers-0 | INFO | PersistBlockTas
25e07ee5e2542f8e9d01612982a74488b1) in 0.001s. Peers: 4
2022-03-06 12:23:07.221+0000 | BFTProcessorExecutor-IBFT-0 | INFO | IbfTBSuCo
controllerBuilder | Produced #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb23b657d
d25caaec2381a0a65b91cd4e00046f87as3fcd9a0906bd724b3ad6)

```

```

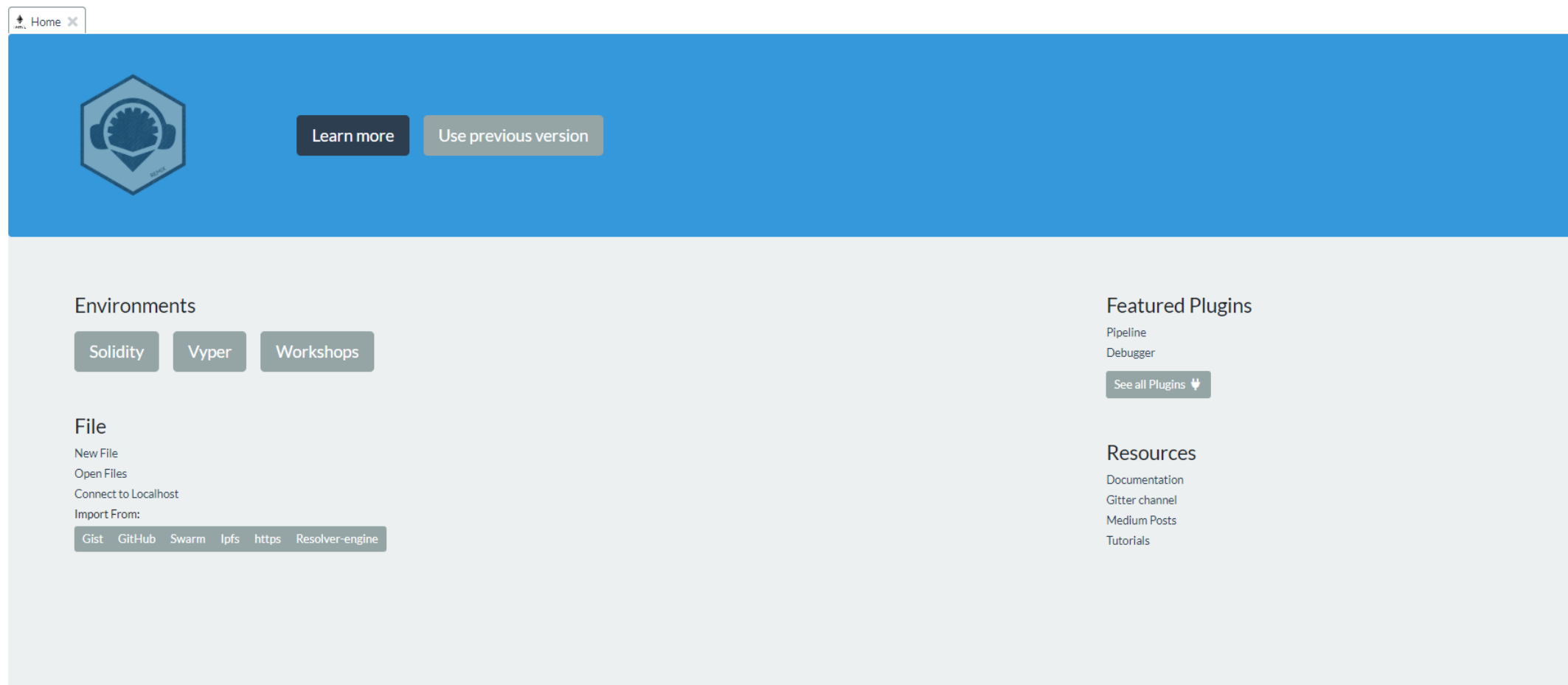
C:\MINGW64-e\besu_privateNetwork\besu_network\node2
k | Imported #856 / 0 tx / 0 om / 0 (0.0%) gas / (0x5ae77f3a97ac3b3e94ab69b676e
57101f7c89d6f454123dbdb61c2f0a53bf37 in 0.026s. Peers: 4
2022-03-06 12:23:05.241+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfTBeSuCo
ntrollerBuilder | Imported #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7c83be94e8abeb9676e57101f7c89d6f454123dbdb61c2f0a53bf37)
2022-03-06 12:23:01.263+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfTBeSuCo
ntrollerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a1bdf1f7c349d5be59c21bbf56e6ad7041ba2b013)
2022-03-06 12:23:03.09+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfTBeSuCo
ntrollerBuilder | Produced #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x727fc37a
914787b1309da23a1055f974737c041960ab4f3cd2c0629e191da8d4d)
2022-03-06 12:23:05.149+09:00 | EthScheduler-Workers-2 | INFO | PersistHotTask
k | Imported #859 / 0 tx / 0 om / 0 (0.0%) gas / (0xca7a8d3201b71daa41431ab10414
f25e07eese2542f9e90d1612982a74488b1) in 0.005s. Peers: 4
2022-03-06 12:23:05.149+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfTBeSuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xca7a8d320
1b71daa41431ab10414f25e07eese2542f9e90d1612982a74488b1)
2022-03-06 12:23:07.234+09:00 | EthScheduler-Workers-0 | INFO | PersistHotTask
k | Imported #860 / 0 tx / 0 om / 0 (0.0%) gas / (0xb823b657dcd25c8ace2381a0a65b
2022-03-06 12:23:07.234+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfTBeSuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b657d
cd25c8ace2381a0a65b91c4e000d4f87a53fcd90096dbf724b3ad6)

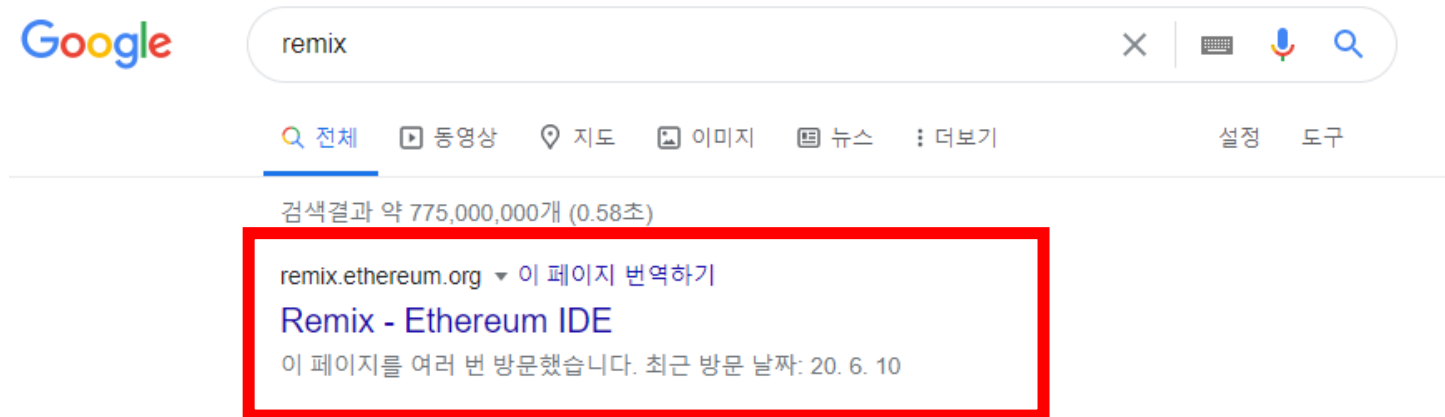
```

```

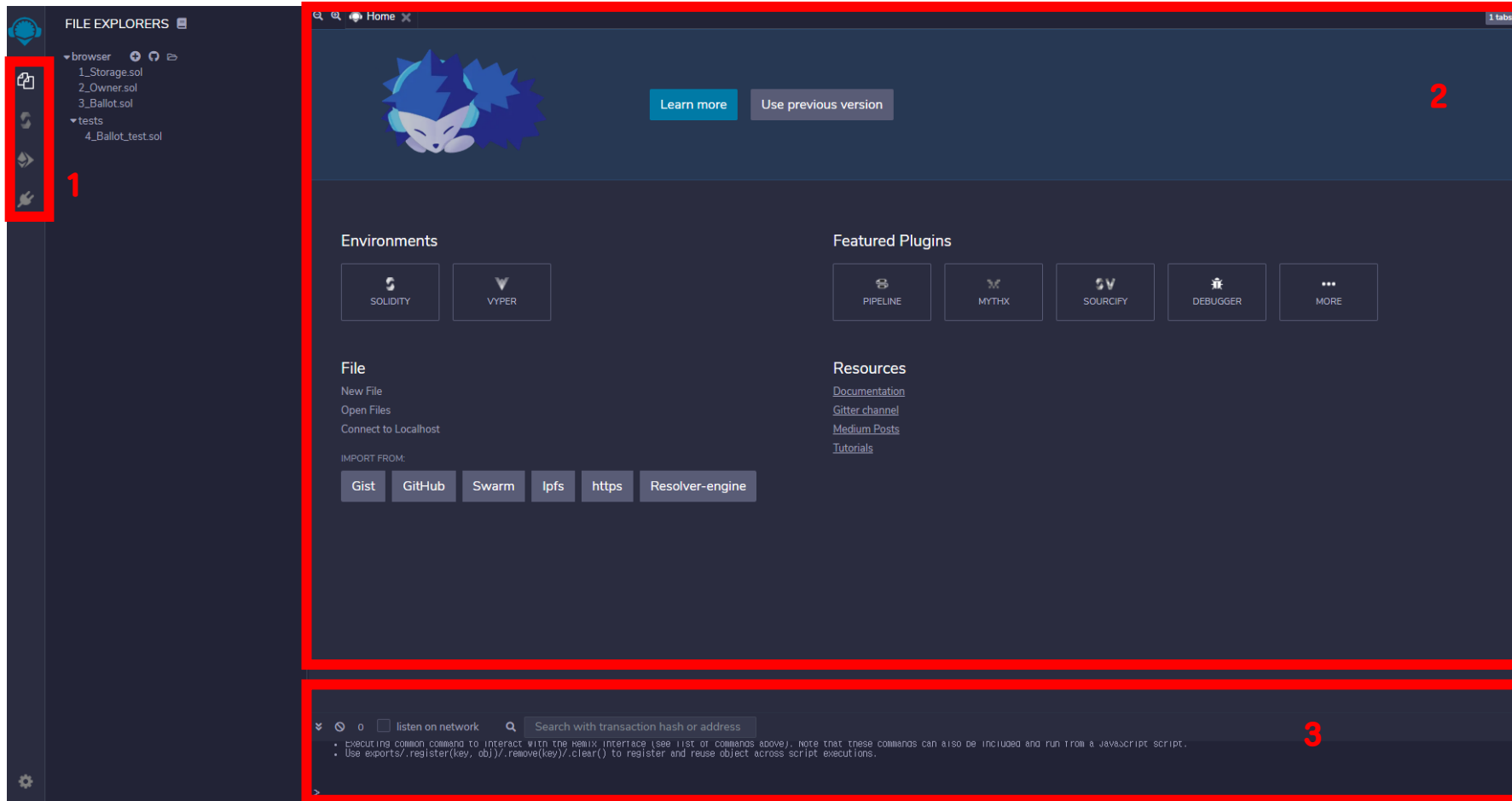
MINGW64: ~/esu_privateNetwork/besu_network/node4
c#41 Imported #855 / 0 tx / 0 om / 0 (0.0%) gas / (0x1370b6dc29011cd78b999c9be5b
k93bbfbee3415f7c5b278571dde771434) in 0.000s. Peers: 4
2022-03-06 12:22:57.204+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #855 / 0 tx / 0 pending / 0 (0.0%) gas / (0x1370b6dc
29011cd78b999c9be5b9c41bbfbee3415f7c5b278571dde771434)
2022-03-06 12:22:59.221+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7ac38be948e6b9676e5701f8c9d6f454123dd6b61c2ff0a53bf37)
2022-03-06 12:23:01.244+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
6037c613a51bdf17c349d8e5e9c921bbf56eadc7041a22b013)
2022-03-06 12:23:03.133+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x727f8c371
914787b1309d2a31055f974737c019604bf3cd2c062e9191ad84d)
2022-03-06 12:23:03.133+09:00 | EThScheduler-Workers-1 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #859 / 0 (0.0%) gas / (0x727f8c371914787b1309d2a3105
5f974737c019604bf3cd2c062e9191ad84d)
2022-03-06 12:23:05.135+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:07.210+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #861 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:09.221+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #862 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:11.244+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #863 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:13.266+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #864 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:15.287+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #865 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:17.308+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #866 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:19.330+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #867 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:21.351+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #868 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:23.372+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #869 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:25.394+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #870 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:27.415+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #871 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:29.436+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #872 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:31.458+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #873 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:33.479+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #874 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:35.500+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #875 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:37.522+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #876 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:39.543+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #877 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:41.565+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #878 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:43.586+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #879 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:45.608+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #880 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:47.629+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #881 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:49.651+09:00 | BfPProcessorExecutor-TBFT-0 | INFO | IbfTBeSuC#
ntrollerBuilder | Imported #882 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b6576
cd25c8ae2381a0a65b91c4e0004d6f87a53fcd9a9006dfb724b3ad6)
2022-03-06 12:23:51.67
```

<https://remix.ethereum.org/>





Remix 활용

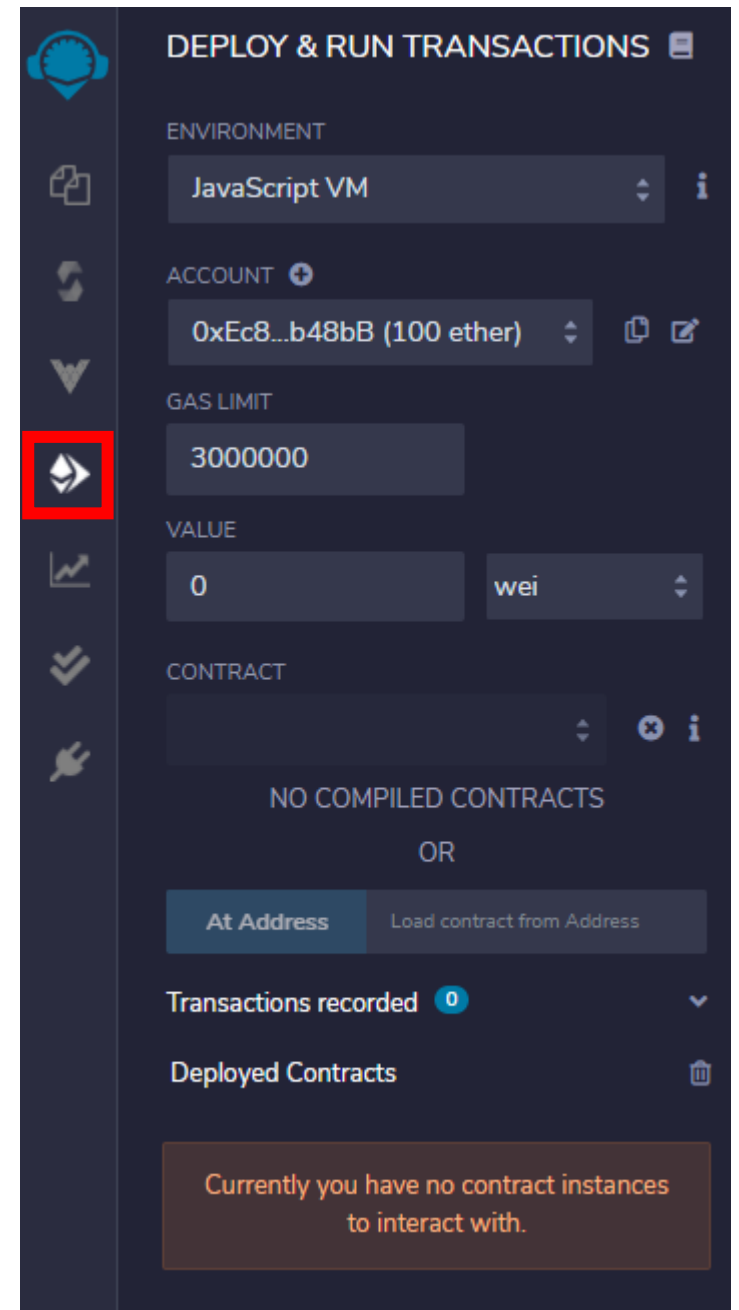
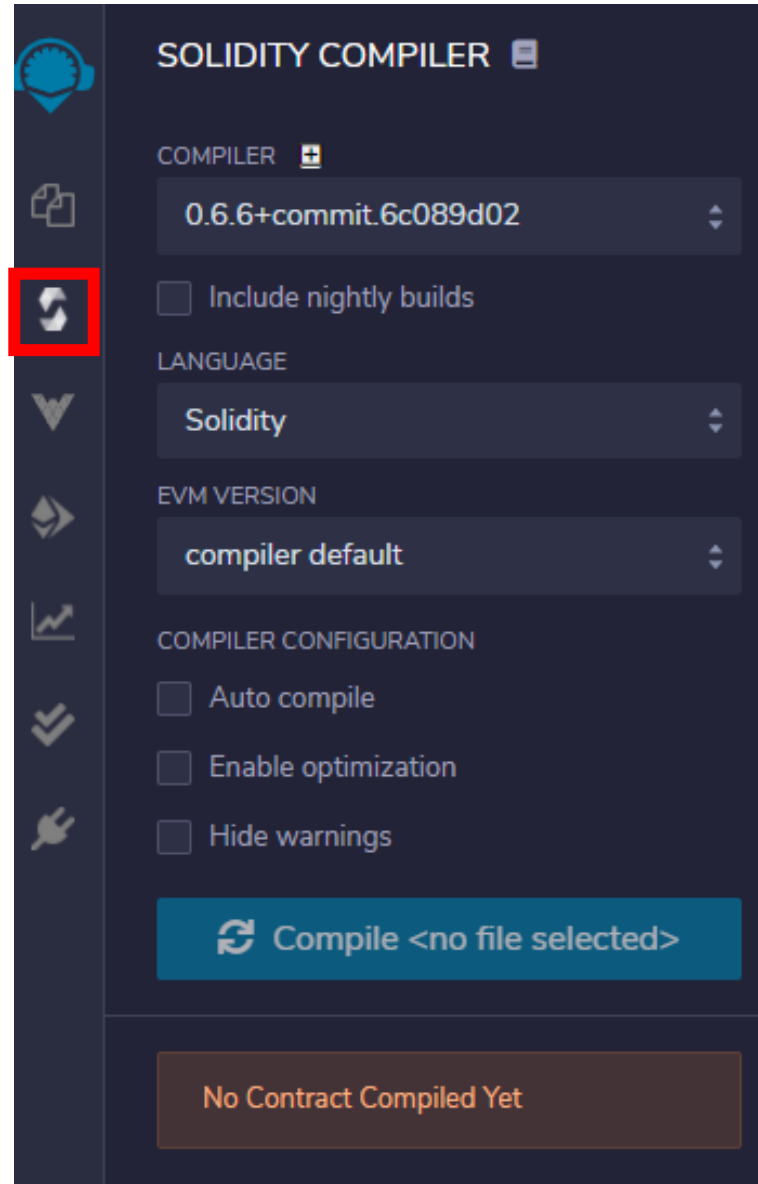
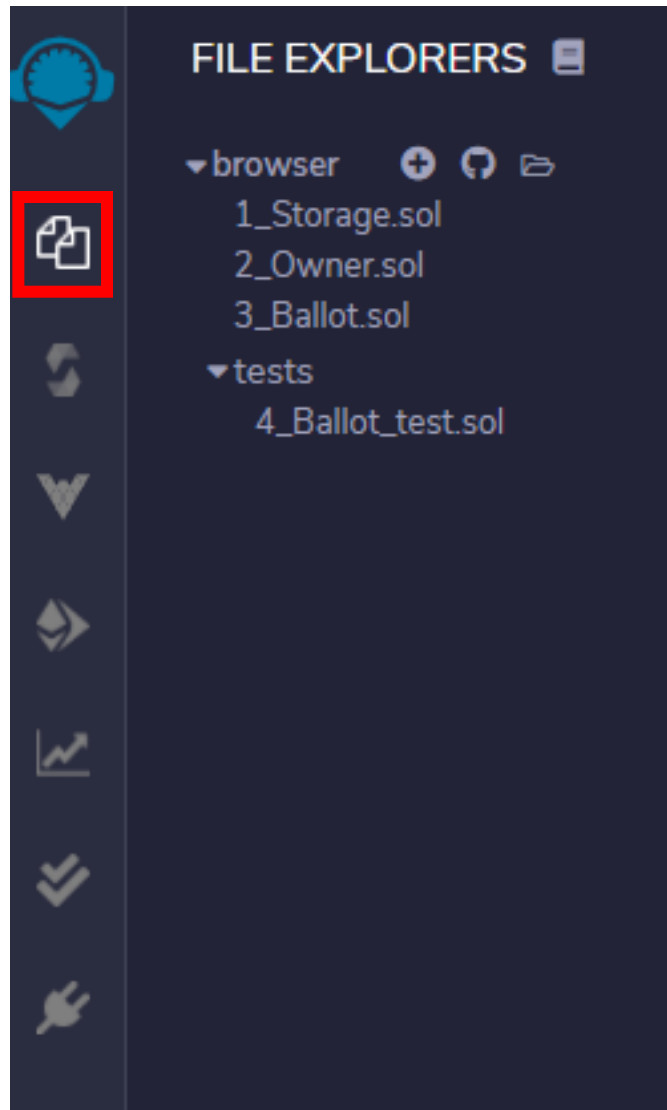


1. 탭

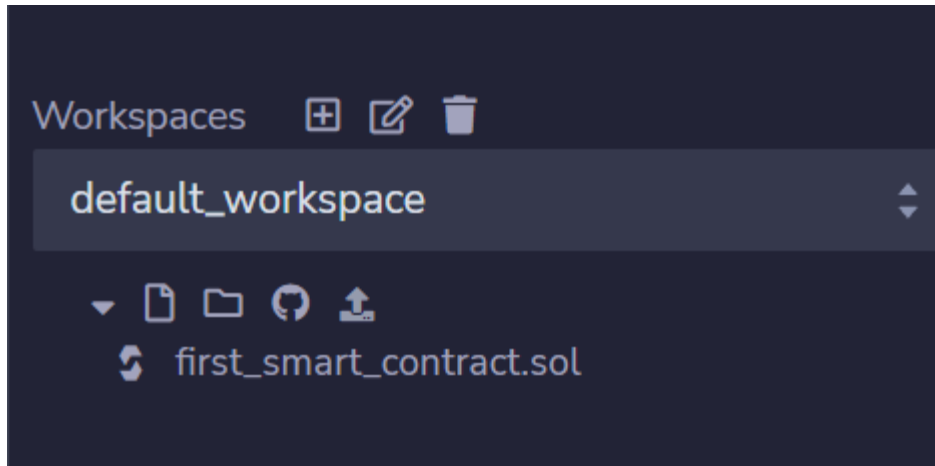
2. 메인 화면

3. 콘솔 화면

Remix 활용

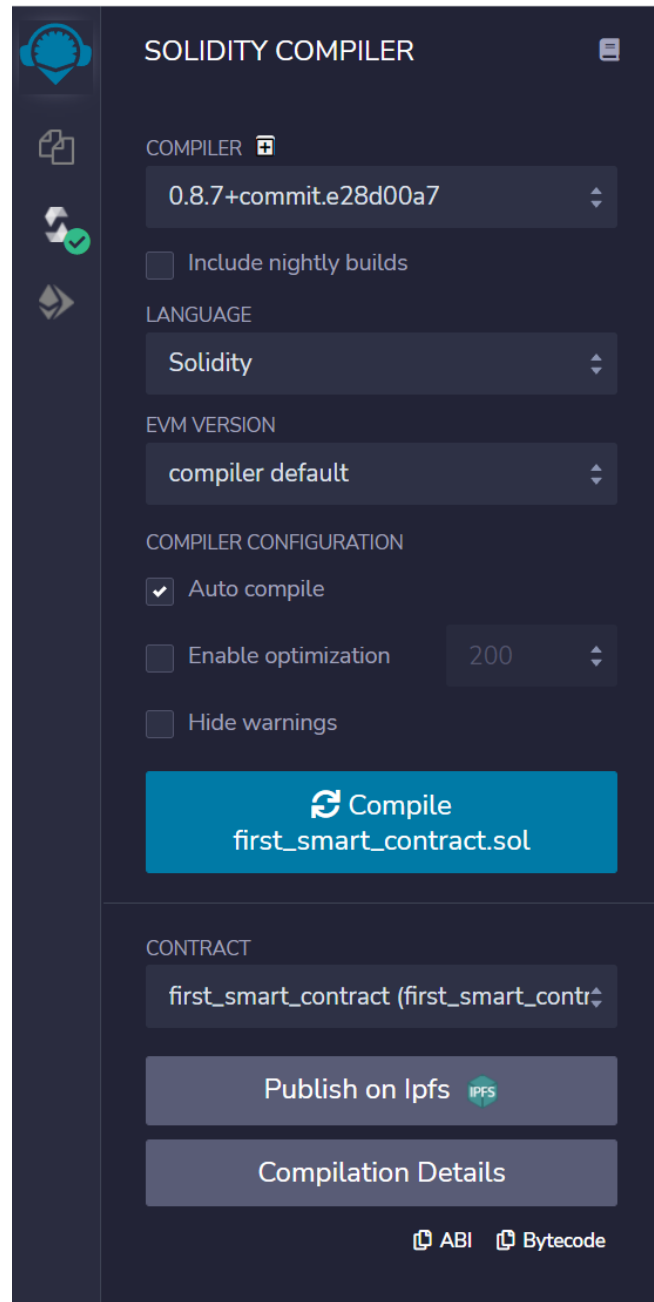


Remix 활용



```
1 // SPDX-License-Identifier: GPL-3.0
2
3 pragma solidity >=0.7.0 <0.9.0;
4
5 contract first_smart_contract {
6
7     string public post_data;
8
9     function postString (string memory data) public {
10         post_data = data;
11     }
12
13     function getString () public view returns (string memory) {
14         return post_data;
15     }
16 }
```

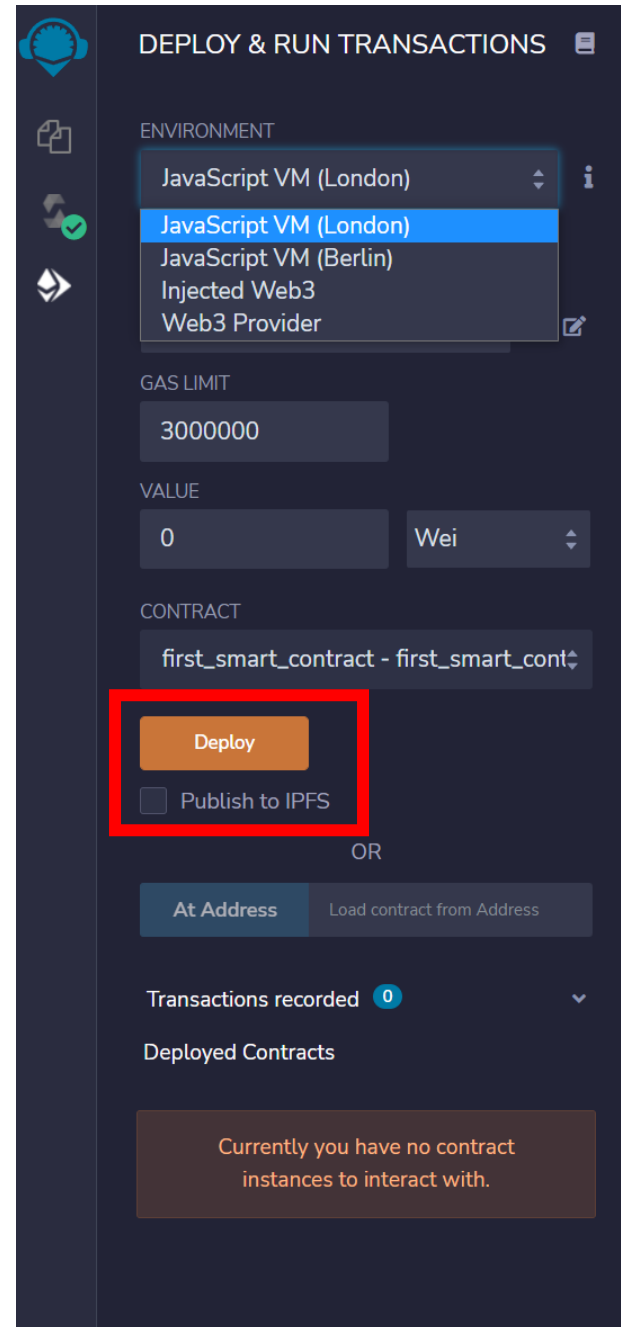
Remix 활용



The screenshot shows the 'SOLIDITY COMPILER' panel in the Remix IDE. The interface is dark-themed. On the left, there are icons for file explorer, compiler, and deployment. The main area contains the following settings:

- COMPILER**: 0.8.7+commit.e28d00a7
- ☐ Include nightly builds
- LANGUAGE**: Solidity
- EVM VERSION**: compiler default
- COMPILER CONFIGURATION**:
 - ☒ Auto compile
 - ☐ Enable optimization (200)
 - ☐ Hide warnings

At the bottom, there is a large blue button labeled 'Compile first_smart_contract.sol'. Below this, the 'CONTRACT' section shows 'first_smart_contract (first_smart_contr' and buttons for 'Publish on Ipfs' and 'Compilation Details'. At the very bottom, there are links for 'ABI' and 'Bytecode'.



The screenshot shows the 'DEPLOY & RUN TRANSACTIONS' panel in the Remix IDE. The interface is dark-themed. On the left, there are icons for file explorer, compiler, and deployment. The main area contains the following settings:

- ENVIRONMENT**: JavaScript VM (London) (selected), JavaScript VM (Berlin), Injected Web3, Web3 Provider
- GAS LIMIT**: 3000000
- VALUE**: 0 Wei
- CONTRACT**: first_smart_contract - first_smart_contr

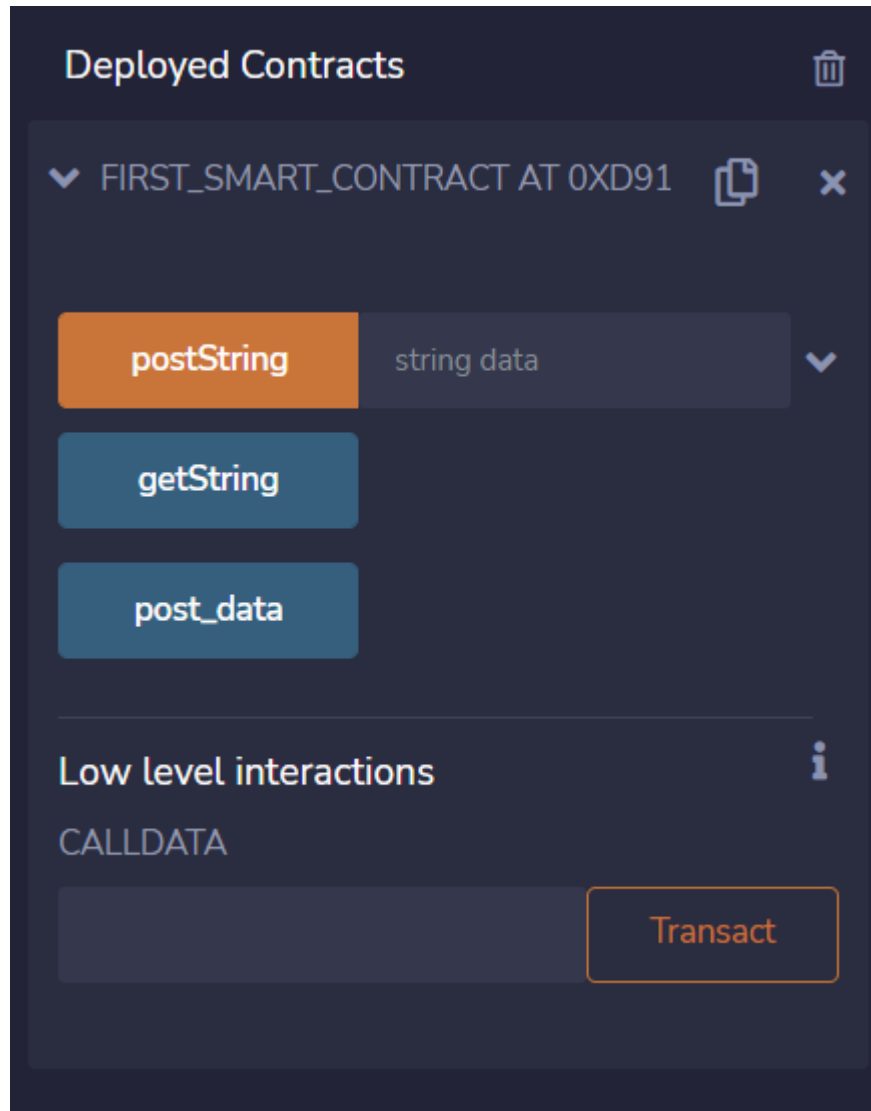
A red box highlights the 'Deploy' button and the 'Publish to IPFS' checkbox. Below these, there is an 'OR' separator and a button labeled 'At Address' with a subtext 'Load contract from Address'. The 'Transactions recorded' section shows '0'. The 'Deployed Contracts' section shows a message: 'Currently you have no contract instances to interact with.'

Remix 활용

The screenshot displays the Remix IDE interface. On the left sidebar, the 'DEPLOY & RUN TRANSACTIONS' panel is active. It shows the environment set to 'JavaScript VM (London)', the account as '0x5B3...eddC4 (99.99999999%)', and the gas limit as '3000000'. The contract name is 'first_smart_contract - first_smart_cont'. A red box highlights the 'At Address' section, which includes a 'Load contract from Address' button and a list of 'Deployed Contracts' showing 'FIRST_SMART_CONTRACT AT 0XD91...'. The main editor displays a Solidity smart contract named 'first_smart_contract.sol' with the following code:

```
1 // SPDX-License-Identifier: GPL-3.0
2
3 pragma solidity >=0.7.0 <0.9.0;
4
5 contract first_smart_contract {
6
7     string public post_data;
8
9     function postString (string memory data) public {
10         post_data = data;
11     }
12
13     function getString () public view returns (string memory) {
14         return post_data;
15     }
16 }
17
```

The bottom panel shows a transaction log with a green checkmark icon. The log entry reads: '[vm] from: 0x5B3...eddC4 to: first_smart_contract.(constructor) value: 0 wei data: 0x608...70033 logs: 0 hash: 0x9b2...c3413'. A red box highlights this log entry. The 'Debug' button is visible to the right of the log entry.



Remix 활용

Deployed Contracts

▼ FIRST_SMART_CONTRACT AT 0XD91

postString hello world

getString

post_data

Low level interactions

CALLDATA

Transact

listen on network

Search with transaction hash or address

transact to first_smart_contract.postString pending ...

✓ [vm] from: 0x5B3...eddC4 to: first_smart_contract.postString(string) 0xd91...39138 value: 0 wei data: 0x025...00000 logs: 0 hash: 0x6b4...1b0b0

▼ FIRST_SMART_CONTRACT AT 0XD91

postString hello world

getString

0: string: hello world

post_data

Low level interactions

CALLDATA

Transact

listen on network

Search with transaction hash or address

call to first_smart_contract.getString

CALL [call] from: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 to: first_smart_contract.getString() data: 0x89e...a642f

Node JS



1. 실습 준비

- 1) 스마트 컨트랙트
- 2) 하이퍼렛저 베수 구동
- 3) Remix 활용
- 4) Web3 사용

2. 토큰 발행 실습

- 1) 토큰 발행 실습

3. 지갑 만들기

- 1) 지갑 만들기 실습

<https://ethereum.org/en/developers/docs/standards/tokens/erc-20/>

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Intro to dapps

Web2 vs Web3

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Nodes and clients

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Ethereum stack ▾

Intro to the stack

Smart contracts

Development networks

Development frameworks

Ethereum client APIs

Data and analytics

Storage

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Advanced ▾

Standards

ERC-20 TOKEN STANDARD

Last edit: [@wackerow](#), December 4, 2021

See contributors

Edit page

Zen Mode

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Examples

Further reading

INTRODUCTION

What is a Token?

Tokens can represent virtually anything in Ethereum:

- reputation points in an online platform
- skills of a character in a game
- lottery tickets
- financial assets like a share in a company
- a fiat currency like USD
- an ounce of gold
- and more...

Such a powerful feature of Ethereum must be handled by a robust standard, right? That's exactly where the ERC-20 plays its role! This standard allows developers to build token applications that are interoperable with other products and services.

What is ERC-20?

The ERC-20 introduces a standard for Fungible Tokens, in other words, they have a property that makes each Token be exactly the same (in type and value) of another Token. For example, an ERC-20 Token acts just like the ETH, meaning that 1 Token is and will always be equal to all the other Tokens.

PREREQUISITES

- [Accounts](#)

Methods

Show less Copy

```
1 function name() public view returns (string)
2 function symbol() public view returns (string)
3 function decimals() public view returns (uint8)
4 function totalSupply() public view returns (uint256)
5 function balanceOf(address _owner) public view returns (uint256
  balance)
6 function transfer(address _to, uint256 _value) public returns (bool
  success)
7 function transferFrom(address _from, address _to, uint256 _value)
  public returns (bool success)
8 function approve(address _spender, uint256 _value) public returns (bool
  success)
9 function allowance(address _owner, address _spender) public view
  returns (uint256 remaining)
10
```

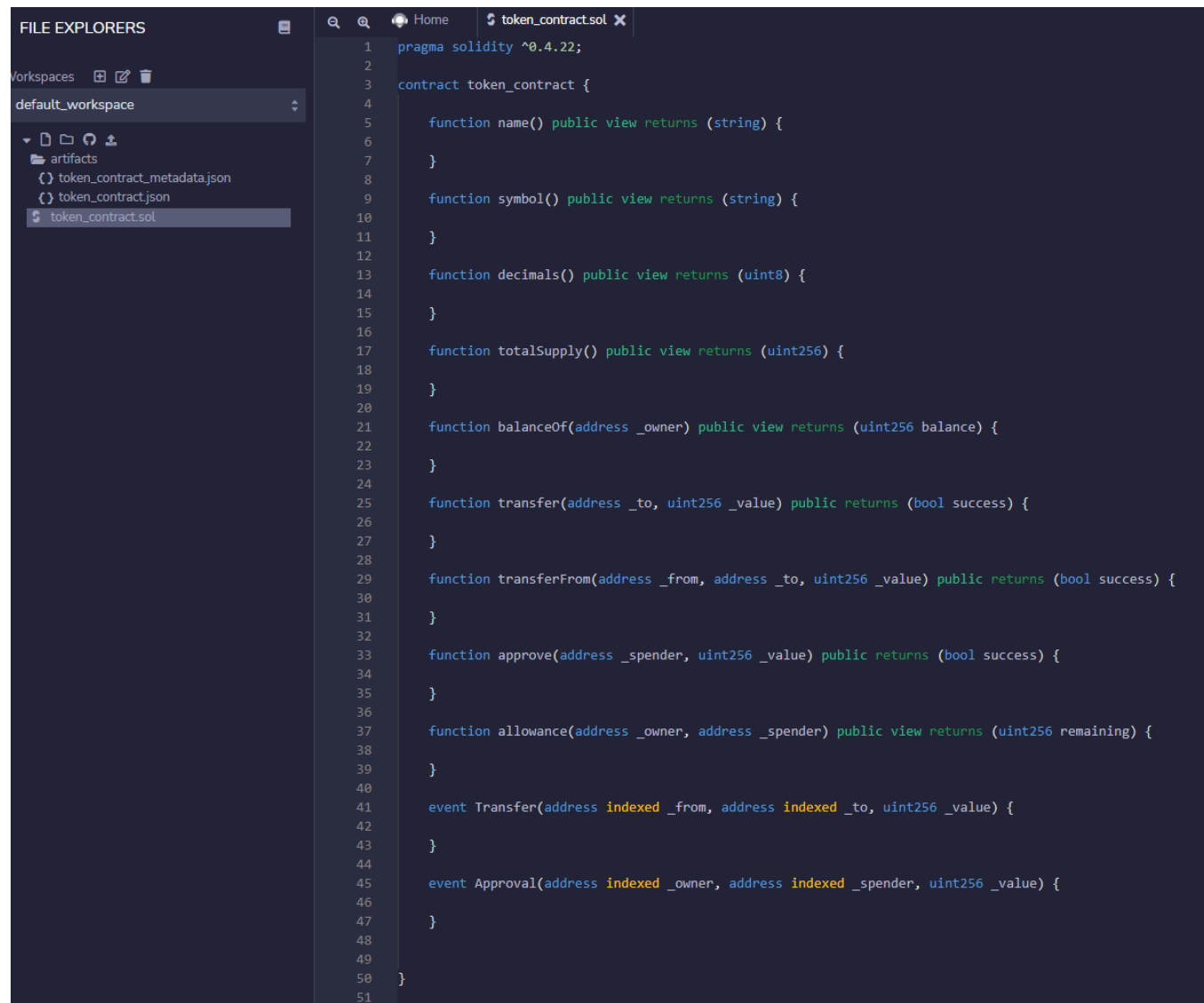
Events

Copy

```
1 event Transfer(address indexed _from, address indexed _to, uint256
  _value)
2 event Approval(address indexed _owner, address indexed _spender, uint256
  _value)
3
```

26


토큰 발행 실습



The image shows a code editor with a dark theme. On the left, the 'FILE EXPLORERS' panel shows a workspace named 'default_workspace' containing a folder 'artifacts' and three files: 'token_contract_metadata.json', 'token_contract.json', and 'token_contract.sol'. The 'token_contract.sol' file is selected. The main editor area shows the Solidity code for the 'token_contract'.

```
1 pragma solidity ^0.4.22;
2
3 contract token_contract {
4
5     function name() public view returns (string) {
6
7     }
8
9     function symbol() public view returns (string) {
10
11    }
12
13    function decimals() public view returns (uint8) {
14
15    }
16
17    function totalSupply() public view returns (uint256) {
18
19    }
20
21    function balanceOf(address _owner) public view returns (uint256 balance) {
22
23    }
24
25    function transfer(address _to, uint256 _value) public returns (bool success) {
26
27    }
28
29    function transferFrom(address _from, address _to, uint256 _value) public returns (bool success) {
30
31    }
32
33    function approve(address _spender, uint256 _value) public returns (bool success) {
34
35    }
36
37    function allowance(address _owner, address _spender) public view returns (uint256 remaining) {
38
39    }
40
41    event Transfer(address indexed _from, address indexed _to, uint256 _value) {
42
43    }
44
45    event Approval(address indexed _owner, address indexed _spender, uint256 _value) {
46
47    }
48
49 }
50
51
```

<https://github.com/OpenZeppelin/openzeppelin-contracts>

 OpenZeppelin / openzeppelin-contracts Public

[Code](#) [Issues 95](#) [Pull requests 30](#) [Actions](#) [Security 5](#) [Insights](#)

master ▾


24 branches


95 tags












Go to file

Add file ▾


Code ▾

 cjxe Fix typo (#3241) ...

✓ c239e1a 2 days ago  2,718 commits

 .github	Update actions/checkout action to v3 (#3234)	5 days ago
 audit	Use "OpenZeppelin Contracts" where appropriate (#2778)	8 months ago
 certora	Add Certora's Governance verification rules (#2997)	2 months ago
 contracts	Fix typo (#3241)	2 days ago
 docs	Simplify ERC721 example (#3115)	last month
 hardhat	Transition from buidler to hardhat	13 months ago
 migrations	Clean up npm package (#904)	4 years ago
 scripts	Fix docs navigation	18 days ago
 test	Extend Governor with parameterized votes (#3043)	5 days ago
 .codecov.yml	Configure Codecov parameters	15 months ago
 .editorconfig	Add documentation for proxies (#2344)	2 years ago


토큰 발행 실습

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master [openzeppelin-contracts / contracts / token /](#) Go to file Add file ...

 **JulissaDantes** Change dependency source to work around Truffle limitation (#3218) ✓ abdb20a 10 days ago [History](#)

..

 ERC1155	Perform ERC1155.afterTokenTransfer hooks before acceptance check (#3215)	12 days ago
 ERC20	Change dependency source to work around Truffle limitation (#3218)	10 days ago
 ERC721	Release v4.5	25 days ago
 ERC777	clarify _spendAllowance natspec (#3188)	22 days ago
 common	Release v4.5	25 days ago

토큰 발행 실습



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master ▾

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master ▾

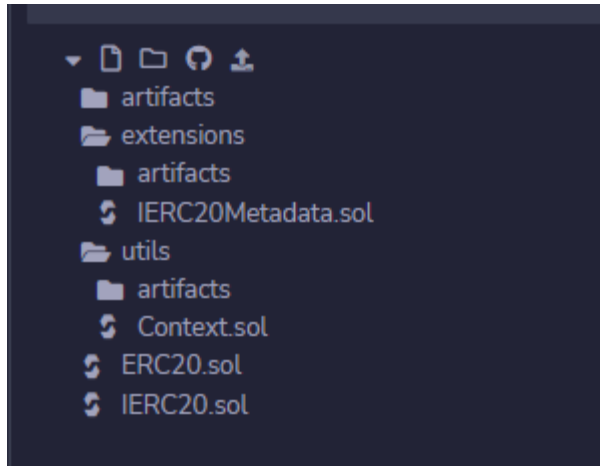
[openzeppelin-contracts](#) / [contracts](#) / [token](#) / [ERC20](#) / [extensions](#) / [IERC20Metadata.sol](#)



master ▾

[openzeppelin-contracts](#) / [contracts](#) / [utils](#) / [Context.sol](#)

토큰 발행 실습



```
ERC20.sol x IERC20Metadata.sol IERC20.sol Context.sol
1 // SPDX-License-Identifier: MIT
2 // OpenZeppelin Contracts (last updated v4.5.0) (token/ERC20/ERC20.sol)
3
4 pragma solidity ^0.8.0;
5
6 import "../IERC20.sol";
7 import "../extensions/IERC20Metadata.sol";
8 import "../utils/Context.sol";
```

```
54 constructor(string memory name_, string memory symbol_, uint256 mint_) {
55     _name = name_;
56     _symbol = symbol_;
57     _mint(msg.sender, mint_);
58 }
```

토큰 발행 실습

SOLIDITY COMPILER

COMPILER

0.8.12+commit.f00d7308

☐ Include nightly builds

LANGUAGE

Solidity

EVM VERSION

compiler default

COMPILER CONFIGURATION

☒ Auto compile

☐ Enable optimization 200

☐ Hide warnings

Compile ERC20.sol

CONTRACT

ERC20 (ERC20.sol)

Publish on Ipfs

Compilation Details

ABI Bytecode

DEPLOY & RUN TRANSACTIONS

ENVIRONMENT

JavaScript VM (London)

VM

ACCOUNT

0x5B3...eddC4 (99.99999999%)

GAS LIMIT

3000000

VALUE

0 Wei

CONTRACT

ERC20 - ERC20.sol

Deploy string name_, string symbol_

☐ Publish to IPFS

OR

At Address Load contract from Address

Transactions recorded 0

Deployed Contracts

Currently you have no contract instances to interact with.

DEPLOY & RUN TRANSACTIONS

ENVIRONMENT

JavaScript VM (London)

VM

ACCOUNT

0x5B3...eddC4 (99.99999999%)

GAS LIMIT

3000000

VALUE

0 Wei

CONTRACT

ERC20 - ERC20.sol

DEPLOY

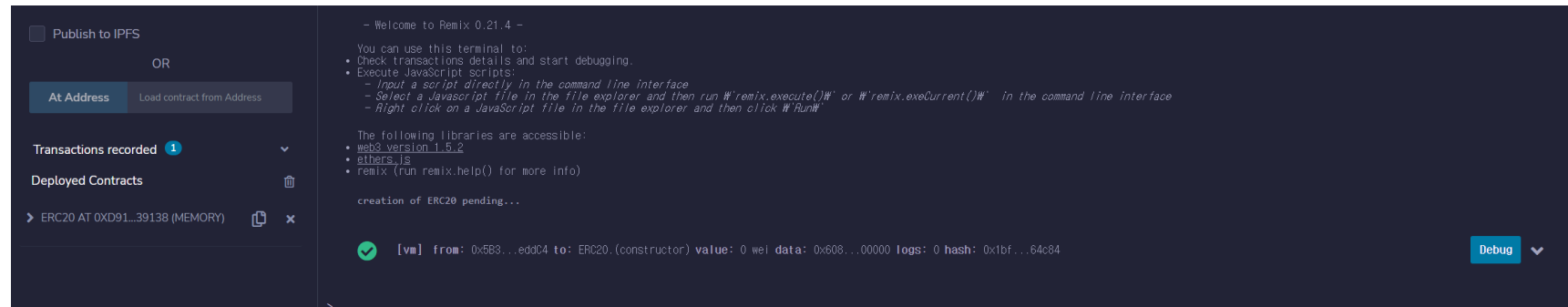
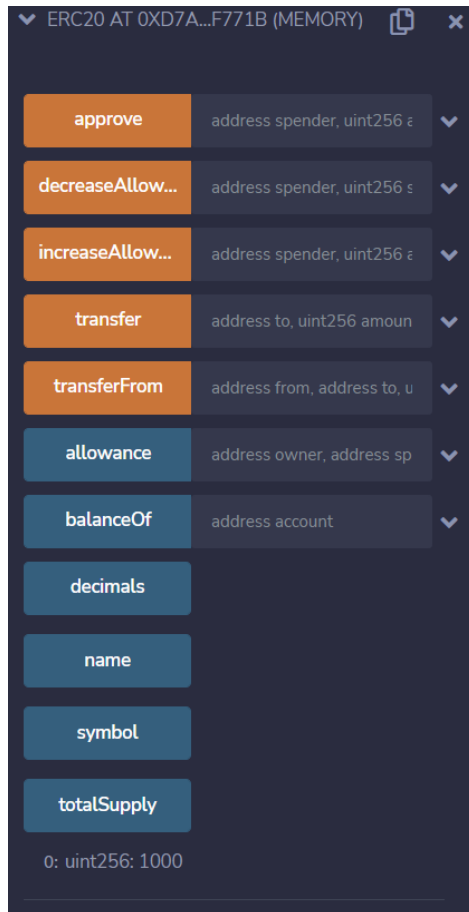
NAME_: st

SYMBOL_: st

MINT_: 1000

transact

토큰 발행 실습



토콘 발행 실습

베수 실행

MINGW64:/e/besu_privateNetwork/besu_network/node1

```
1H60L3dwYN03Cd1-dbnRwn2F, nodeId=0x87e53fc9ba07935464950dd7b2e2e54b1f1edast
e33d5a4c463daf85cb96dc85fee31c247c0862d58bea0c7eaeedc, udpAddress=Optional[127.0.0.1:30304], tcpAddress=Optional[127.0.0.1:30304], asBase64=3e4QF0m3XW-38V
P5YudlCQ14ecExjPAUtybXxT1n6p9sb1AA1PAH0NjRR84t-9nJlPhLRdyP_c1ptPV9C9ce80igZV0a
WfGHd5eK1Agm1kgN0y1uHh8AAAGCzVjvCD11Mmx0Q9L6B8m-MWkxGPNv4XL1tyFv_uWCJKAaC1
VhD58u1N0Y3CCmD8R0wgnZ, nodeId=0x87e53fc9ba07935464950dd7b2e2e54b1f1edast
4861c3f3994aa16555c3b, customFields={tcp=30304, udp=30304, ip=0x7F000001, eth=1
[0x575278a8, 0x]}, id=v4, secp256k1=0x03fa2c17b79be33d5a4c463daf85cb96dc85fee31
c247c0862d58bea0c7eaeedc}
2022-03-06 12:22:42.661+09:00 | main | INFO | DefaultP2PNetwork | Enode URL eno
de://fa2c17b79be33d5a4c463daf85cb96dc85fee31c247c0862d58bea0c7eaeedc11872275c07
238d51ba983201c0300f6e1ab850bc192ad98f13fce3b5da670127.0.0.1:30304
2022-03-06 12:22:42.663+09:00 | main | INFO | DefaultP2PNetwork | Node address
0x61e71e67841ac08ceca4861c3f23994aa16555c3b
2022-03-06 12:22:42.666+09:00 | main | INFO | Defaultsynchronizer | Starting sy
nchronizer
2022-03-06 12:22:42.674+09:00 | main | INFO | FullSyncDownloader | Starting ful
l sync
2022-03-06 12:22:37.686+09:00 | main | INFO | FullSyncTargetManager | No sync t
arget, waiting for peers. Current peers: 0
2022-03-06 12:22:37.941+09:00 | main | INFO | Runner | Ethereum main loop is up
2022-03-06 12:22:42.699+09:00 | EthScheduler-Timer-0 | INFO | FullSyncTargetMa
nager | No sync target, waiting for peers. Current peers: 0
2022-03-06 12:22:43.216+09:00 | nioEventLoopGroup-3-1 | INFO | FullSyncTargetMa
nager | No sync target, waiting for peers. Current peers: 1
2022-03-06 12:22:47.826+09:00 | nioEventLoopGroup-3-1 | INFO | SyncTargetManage
r | Found common ancestor with peer Peer 0xfa2c17b79be33d5a4c... at block 850
```

MINGW64:/e/besu_privateNetwork/besu_network/node2

```
e33d5a4c463daf85cb96dc85fee31c247c0862d58bea0c7eaeedc, udpAddress=Optional[127.0.0.1:30304], tcpAddress=Optional[127.0.0.1:30304], asBase64=3e4QF0m3XW-38V
P5YudlCQ14ecExjPAUtybXxT1n6p9sb1AA1PAH0NjRR84t-9nJlPhLRdyP_c1ptPV9C9ce80igZV0a
WfGHd5eK1Agm1kgN0y1uHh8AAAGCzVjvCD11Mmx0Q9L6B8m-MWkxGPNv4XL1tyFv_uWCJKAaC1
VhD58u1N0Y3CCmD8R0wgnZ, nodeId=0x87e53fc9ba07935464950dd7b2e2e54b1f1edast
4861c3f3994aa16555c3b, customFields={tcp=30304, udp=30304, ip=0x7F000001, eth=1
[0x575278a8, 0x]}, id=v4, secp256k1=0x03fa2c17b79be33d5a4c463daf85cb96dc85fee31
c247c0862d58bea0c7eaeedc}
2022-03-06 12:22:42.661+09:00 | main | INFO | DefaultP2PNetwork | Enode URL eno
de://fa2c17b79be33d5a4c463daf85cb96dc85fee31c247c0862d58bea0c7eaeedc11872275c07
238d51ba983201c0300f6e1ab850bc192ad98f13fce3b5da670127.0.0.1:30304
2022-03-06 12:22:42.663+09:00 | main | INFO | DefaultP2PNetwork | Node address
0x61e71e67841ac08ceca4861c3f23994aa16555c3b
2022-03-06 12:22:42.666+09:00 | main | INFO | Defaultsynchronizer | Starting sy
nchronizer
2022-03-06 12:22:42.674+09:00 | main | INFO | FullSyncDownloader | Starting ful
l sync
2022-03-06 12:22:42.676+09:00 | main | INFO | FullSyncTargetManager | No sync t
arget, waiting for peers. Current peers: 0
2022-03-06 12:22:43.008+09:00 | main | INFO | Runner | Ethereum main loop is up
2022-03-06 12:22:43.215+09:00 | nioEventLoopGroup-3-2 | INFO | FullSyncTargetMa
nager | No sync target, waiting for peers. Current peers: 2
```

MINGW64:/e/besu_privateNetwork/besu_network/node3

```
24b4e495d7e547824b7c0c07d5dc0d3531ae96e26dbb281ef, udpAddress=Optional[127.0.0.1:30305], tcpAddress=Optional[127.0.0.1:30305], asBase64=3e4QF0m3XW-38V
P5YudlCQ14ecExjPAUtybXxT1n6p9sb1AA1PAH0NjRR84t-9nJlPhLRdyP_c1ptPV9C9ce80igZV0a
WfGHd5eK1Agm1kgN0y1uHh8AAAGCzVjvCD11Mmx0Q9L6B8m-MWkxGPNv4XL1tyFv_uWCJKAaC1
VhD58u1N0Y3CCmD8R0wgnZ, nodeId=0x87e53fc9ba07935464950dd7b2e2e54b1f1edast
4861c3f3994aa16555c3b, customFields={tcp=30305, udp=30305, ip=0x7F000001, eth=1
[0x575278a8, 0x]}, id=v4, secp256k1=0x02fb7862c95802a4be4a95d7e547824b7c0c07d5dc0d3531ae96e26dbb281ef
2022-03-06 12:22:47.361+09:00 | main | INFO | DefaultP2PNetwork | Enode URL eno
de://fb7862c95802a4be4a95d7e547824b7c0c07d5dc0d3531ae96e26dbb281ef1d93b6f886
9a715b6f2703c5601d068c9f2ef49804d1c4d6d21c8abb11c88127.0.0.1:30305
2022-03-06 12:22:47.362+09:00 | main | INFO | DefaultP2PNetwork | Node address
x952bae1dd731bc375f784d1990fddcf7e0cf7b38
2022-03-06 12:22:47.367+09:00 | main | INFO | Defaultsynchronizer | Starting sy
nchronizer
2022-03-06 12:22:47.370+09:00 | main | INFO | FullSyncDownloader | Starting ful
l sync
2022-03-06 12:22:47.371+09:00 | main | INFO | FullSyncTargetManager | No sync t
arget, waiting for peers. Current peers: 0
2022-03-06 12:22:47.687+09:00 | main | INFO | Runner | Ethereum main loop is up
2022-03-06 12:22:47.790+09:00 | nioEventLoopGroup-3-4 | INFO | FullSyncTargetMa
nager | No sync target, waiting for peers. Current peers: 3
```

MINGW64:/e/besu_privateNetwork/besu_network/node4

```
1 schedule created with milestones: [MuirGlacier: 0]
2022-03-06 12:22:49.568+09:00 | main | INFO | RunnerBuilder | Detecting NAT ser
vice.
2022-03-06 12:22:49.702+09:00 | main | INFO | Runner | Starting external servic
es...
2022-03-06 12:22:49.703+09:00 | main | INFO | WebsocketService | Starting Webso
cket service on 127.0.0.1:8548
2022-03-06 12:22:50.468+09:00 | vert.x-eventloop-thread-1 | INFO | WebsocketSer
vice | Websocket service started and listening on 127.0.0.1:8548
2022-03-06 12:22:50.470+09:00 | main | INFO | AutoTransactionLogBloomCachingSer
vice | Starting auto transaction log bloom caching service
2022-03-06 12:22:50.472+09:00 | main | INFO | LogBloomCacheMetadata | Lookup ca
che metadata file in data directory: E:\besu_privateNetwork\besu_network\node4\d
ata\caches
2022-03-06 12:22:50.484+09:00 | main | INFO | Runner | Starting Ethereum main l
oop...
2022-03-06 12:22:50.484+09:00 | main | INFO | NatService | No NAT environment d
etected so no service could be started
2022-03-06 12:22:50.485+09:00 | main | INFO | NetworkRunner | Starting Network.
2022-03-06 12:22:50.491+09:00 | nioEventLoopGroup-2-1 | INFO | RlpAgent | P2P
Rlp agent started and listening on /0x0300000000:30306
2022-03-06 12:22:50.492+09:00 | main | INFO | PeerDiscoveryAgent | Starting pee
r discovery agent on host=0.0.0.0, port=30306
```

MINGW64:/e/besu_privateNetwork/besu_network/node5

```
ntrollerBuilder | Produced #855 / 0 tx / 0 pending / 0 (0.0%) gas / (0x1370b6dc
29011cd789b99c9be5bc943bbfb6e3415ff3c5b278571dde7751434)
2022-03-06 12:22:59.251+09:00 | EthScheduler-Workers-0 | INFO | PersistBlockTas
k | Imported #856 / 0 tx / 0 om / 0 (0.0%) gas / (0x5ae77f3a97ac83be948e6b9b676e
57101fc89d6f454123ddb6b1c2ff0a53bf37) in 0.011s. Peers: 3
2022-03-06 12:22:59.253+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7ac83be948e6b9b676e57101fc89d6f454123ddb6b1c2ff0a53bf37)
2022-03-06 12:23:01.263+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:01.255+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:03.124+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x772f8c371
914787b1309d2a31055f974f37c0419604bf3cd2c062e919e1ad84d)
2022-03-06 12:23:05.141+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Produced #859 / 0 tx / 0 pending / 0 (0.0%) gas / (0xca7a8d320
1b71daa414314b10414f25e07ee52542febe90d1612982a74488b1)
2022-03-06 12:23:07.247+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b657d
c25c8aec2381a0a65b91c4e000d46f87a53fcd90096dbf24b3ad6) in 0.010s. Peers: 3
```

MINGW64:/e/besu_privateNetwork/besu_network/node6

```
ntrollerBuilder | Imported #854 / 0 tx / 0 pending / 0 (0.0%) gas / (0x4ee72cfcb
4b677af228a65c262b9bbdbf9454781e396cafa4d345d2cbbca533)
2022-03-06 12:22:57.253+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #855 / 0 tx / 0 pending / 0 (0.0%) gas / (0x1370b6dc
29011cd789b99c9be5bc943bbfb6e3415ff3c5b278571dde7751434)
2022-03-06 12:22:59.196+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Produced #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7ac83be948e6b9b676e57101fc89d6f454123ddb6b1c2ff0a53bf37)
2022-03-06 12:23:01.257+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:03.124+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x772f8c371
914787b1309d2a31055f974f37c0419604bf3cd2c062e919e1ad84d)
2022-03-06 12:23:05.146+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #859 / 0 tx / 0 pending / 0 (0.0%) gas / (0xca7a8d320
1b71daa414314b10414f25e07ee52542febe90d1612982a74488b1)
2022-03-06 12:23:05.155+09:00 | EthScheduler-Workers-0 | INFO | PersistBlockTas
k | Imported #856 / 0 tx / 0 om / 0 (0.0%) gas / (0x5ae77f3a97ac83be948e6b9b676e
57101fc89d6f454123ddb6b1c2ff0a53bf37) in 0.026s. Peers: 4
2022-03-06 12:22:59.234+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7ac83be948e6b9b676e57101fc89d6f454123ddb6b1c2ff0a53bf37)
2022-03-06 12:23:01.263+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:03.124+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Produced #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x72f8c371
914787b1309d2a31055f974f37c0419604bf3cd2c062e919e1ad84d)
2022-03-06 12:23:05.149+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #859 / 0 tx / 0 om / 0 (0.0%) gas / (0xca7a8d3201b71daa
414314b10414f25e07ee52542febe90d1612982a74488b1)
2022-03-06 12:23:07.247+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0x772f8c371
914787b1309d2a31055f974f37c0419604bf3cd2c062e919e1ad84d)
2022-03-06 12:23:07.234+09:00 | EthScheduler-Workers-2 | INFO | PersistBlockTas
k | Imported #859 / 0 tx / 0 om / 0 (0.0%) gas / (0xca7a8d3201b71daa414314b1041
4f25e07ee52542febe90d1612982a74488b1) in 0.005s. Peers: 4
2022-03-06 12:23:05.149+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #859 / 0 tx / 0 pending / 0 (0.0%) gas / (0xca7a8d320
1b71daa414314b10414f25e07ee52542febe90d1612982a74488b1)
2022-03-06 12:23:07.234+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b657d
c25c8aec2381a0a65b91c4e000d46f87a53fcd90096dbf24b3ad6)
2022-03-06 12:23:07.234+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b657d
c25c8aec2381a0a65b91c4e000d46f87a53fcd90096dbf24b3ad6)
```

MINGW64:/e/besu_privateNetwork/besu_network/node7

```
ntrollerBuilder | Imported #854 / 0 tx / 0 pending / 0 (0.0%) gas / (0x4ee72cfcb
4b677af228a65c262b9bbdbf9454781e396cafa4d345d2cbbca533)
2022-03-06 12:22:57.253+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #855 / 0 tx / 0 pending / 0 (0.0%) gas / (0x1370b6dc
29011cd789b99c9be5bc943bbfb6e3415ff3c5b278571dde7751434)
2022-03-06 12:22:59.196+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Produced #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7ac83be948e6b9b676e57101fc89d6f454123ddb6b1c2ff0a53bf37)
2022-03-06 12:23:01.257+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:03.124+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x772f8c371
914787b1309d2a31055f974f37c0419604bf3cd2c062e919e1ad84d)
2022-03-06 12:23:05.146+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #859 / 0 tx / 0 pending / 0 (0.0%) gas / (0xca7a8d320
1b71daa414314b10414f25e07ee52542febe90d1612982a74488b1)
2022-03-06 12:23:05.155+09:00 | EthScheduler-Workers-0 | INFO | PersistBlockTas
k | Imported #856 / 0 tx / 0 om / 0 (0.0%) gas / (0x5ae77f3a97ac83be948e6b9b676e
57101fc89d6f454123ddb6b1c2ff0a53bf37) in 0.000s. Peers: 4
2022-03-06 12:22:57.242+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #855 / 0 tx / 0 pending / 0 (0.0%) gas / (0x1370b6dc
29011cd789b99c9be5bc943bbfb6e3415ff3c5b278571dde7751434)
2022-03-06 12:22:59.221+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7ac83be948e6b9b676e57101fc89d6f454123ddb6b1c2ff0a53bf37)
2022-03-06 12:23:01.244+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Produced #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:03.133+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x772f8c371
914787b1309d2a31055f974f37c0419604bf3cd2c062e919e1ad84d)
2022-03-06 12:23:03.133+09:00 | EthScheduler-Workers-1 | INFO | PersistBlockTas
k | Imported #858 / 0 tx / 0 om / 0 (0.0%) gas / (0x772f8c371914787b1309d2a31055
f974f37c0419604bf3cd2c062e919e1ad84d) in 0.005s. Peers: 4
2022-03-06 12:23:05.135+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #859 / 0 tx / 0 om / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:07.210+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b657d
c25c8aec2381a0a65b91c4e000d46f87a53fcd90096dbf24b3ad6)
2022-03-06 12:23:07.210+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b657d
c25c8aec2381a0a65b91c4e000d46f87a53fcd90096dbf24b3ad6)
```


MINGW64:/e/besu_privateNetwork/besu_network/node8

```
ntrollerBuilder | Imported #854 / 0 tx / 0 pending / 0 (0.0%) gas / (0x4ee72cfcb
4b677af228a65c262b9bbdbf9454781e396cafa4d345d2cbbca533)
2022-03-06 12:22:57.253+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #855 / 0 tx / 0 pending / 0 (0.0%) gas / (0x1370b6dc
29011cd789b99c9be5bc943bbfb6e3415ff3c5b278571dde7751434)
2022-03-06 12:22:59.196+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Produced #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7ac83be948e6b9b676e57101fc89d6f454123ddb6b1c2ff0a53bf37)
2022-03-06 12:23:01.257+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:03.124+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x772f8c371
914787b1309d2a31055f974f37c0419604bf3cd2c062e919e1ad84d)
2022-03-06 12:23:05.146+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #859 / 0 tx / 0 pending / 0 (0.0%) gas / (0xca7a8d320
1b71daa414314b10414f25e07ee52542febe90d1612982a74488b1)
2022-03-06 12:23:05.155+09:00 | EthScheduler-Workers-0 | INFO | PersistBlockTas
k | Imported #856 / 0 tx / 0 om / 0 (0.0%) gas / (0x5ae77f3a97ac83be948e6b9b676e
57101fc89d6f454123ddb6b1c2ff0a53bf37) in 0.000s. Peers: 4
2022-03-06 12:22:57.242+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #855 / 0 tx / 0 pending / 0 (0.0%) gas / (0x1370b6dc
29011cd789b99c9be5bc943bbfb6e3415ff3c5b278571dde7751434)
2022-03-06 12:22:59.221+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #856 / 0 tx / 0 pending / 0 (0.0%) gas / (0x5ae77f3a9
7ac83be948e6b9b676e57101fc89d6f454123ddb6b1c2ff0a53bf37)
2022-03-06 12:23:01.244+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Produced #857 / 0 tx / 0 pending / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:03.133+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #858 / 0 tx / 0 pending / 0 (0.0%) gas / (0x772f8c371
914787b1309d2a31055f974f37c0419604bf3cd2c062e919e1ad84d)
2022-03-06 12:23:03.133+09:00 | EthScheduler-Workers-1 | INFO | PersistBlockTas
k | Imported #858 / 0 tx / 0 om / 0 (0.0%) gas / (0x772f8c371914787b1309d2a31055
f974f37c0419604bf3cd2c062e919e1ad84d) in 0.005s. Peers: 4
2022-03-06 12:23:05.135+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #859 / 0 tx / 0 om / 0 (0.0%) gas / (0x7206b5357
a36037c613a51bdf1f7c349de5be59c921bbf56e6adc7041ba2b013)
2022-03-06 12:23:07.210+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b657d
c25c8aec2381a0a65b91c4e000d46f87a53fcd90096dbf24b3ad6)
2022-03-06 12:23:07.210+09:00 | BftProcessorExecutor-IBFT-0 | INFO | IbfBtBesuCo
ntrollerBuilder | Imported #860 / 0 tx / 0 pending / 0 (0.0%) gas / (0xb823b657d
c25c8aec2381a0a65b91c4e000d46f87a53fcd90096dbf24b3ad6)
```


34



토큰 발행 실습

ENVIRONMENT

Injected Web3 

Custom (1337) network


ACCOUNT 

0x9D9...02325 (10200 ether)  


GAS LIMIT

3000000

VALUE

0 Wei 


CONTRACT


IERC20 - IERC20.sol 

Deploy

☐ Publish to IPFS

CONTRACT


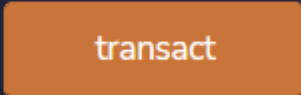
ERC20 - ERC20.sol 

DEPLOY 

NAME_: jw

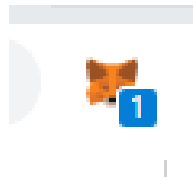
SYMBOL_: jw

MINT_: 9000000000000000000

토큰 발행 실습

creation of ERC20 pending...



test_network

Account 15 → 새 계약

<https://remix.ethereum.org>

계약 배포

세부 정보 데이터

편집

예상 가스 요금 ⓘ 0 0 ETH
제한 사이트 최대 요금 0 ETH

합계 0 0 ETH
금액 + 가스 요금 최대 금액: 0 ETH

거부 확인

Deployed Contracts

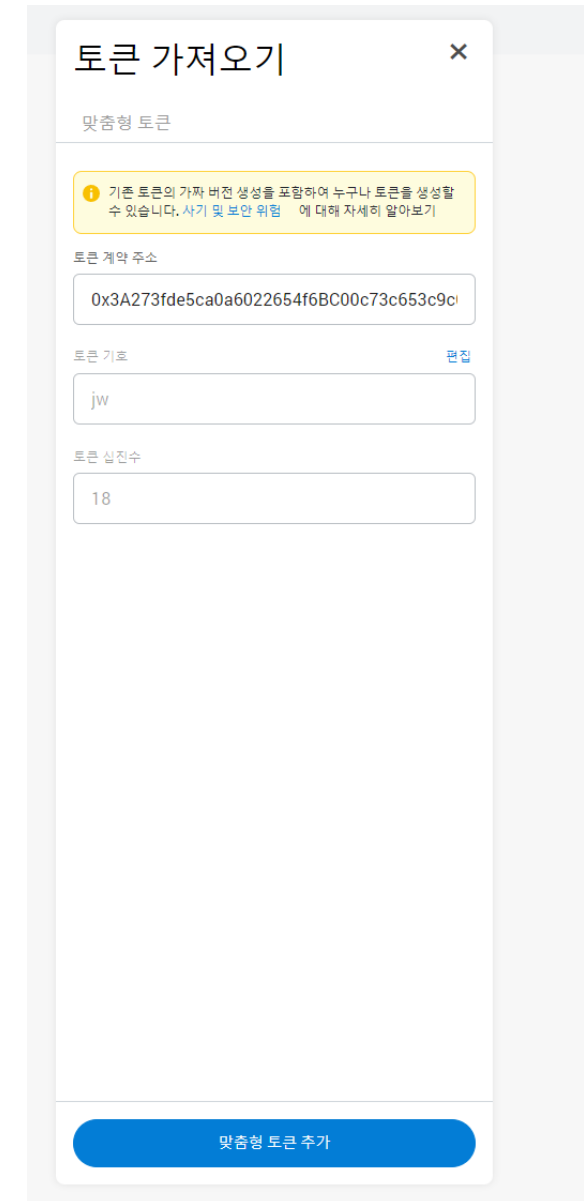
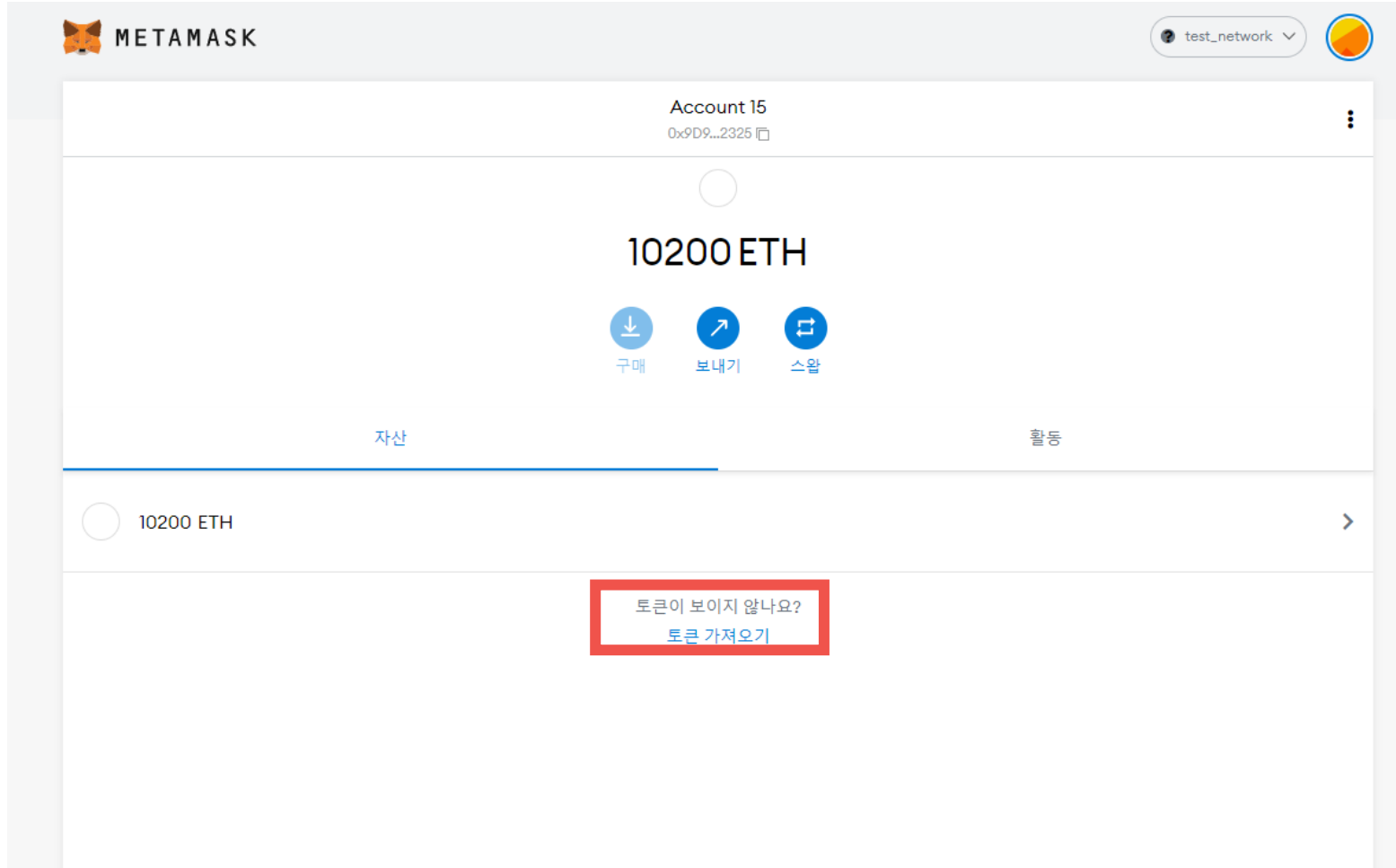
ERC20 AT 0X3A2...C0CFD (BLOCK-H) [copy] [x]

approve	address spender, uint256 z	▼
decreaseAllow...	address spender, uint256 s	▼
increaseAllow...	address spender, uint256 z	▼
transfer	address to, uint256 amoun	▼
transferFrom	address from, address to, u	▼
allowance	address owner, address sp	▼
balanceOf	address account	▼
decimals		
name		
symbol		
totalSupply		

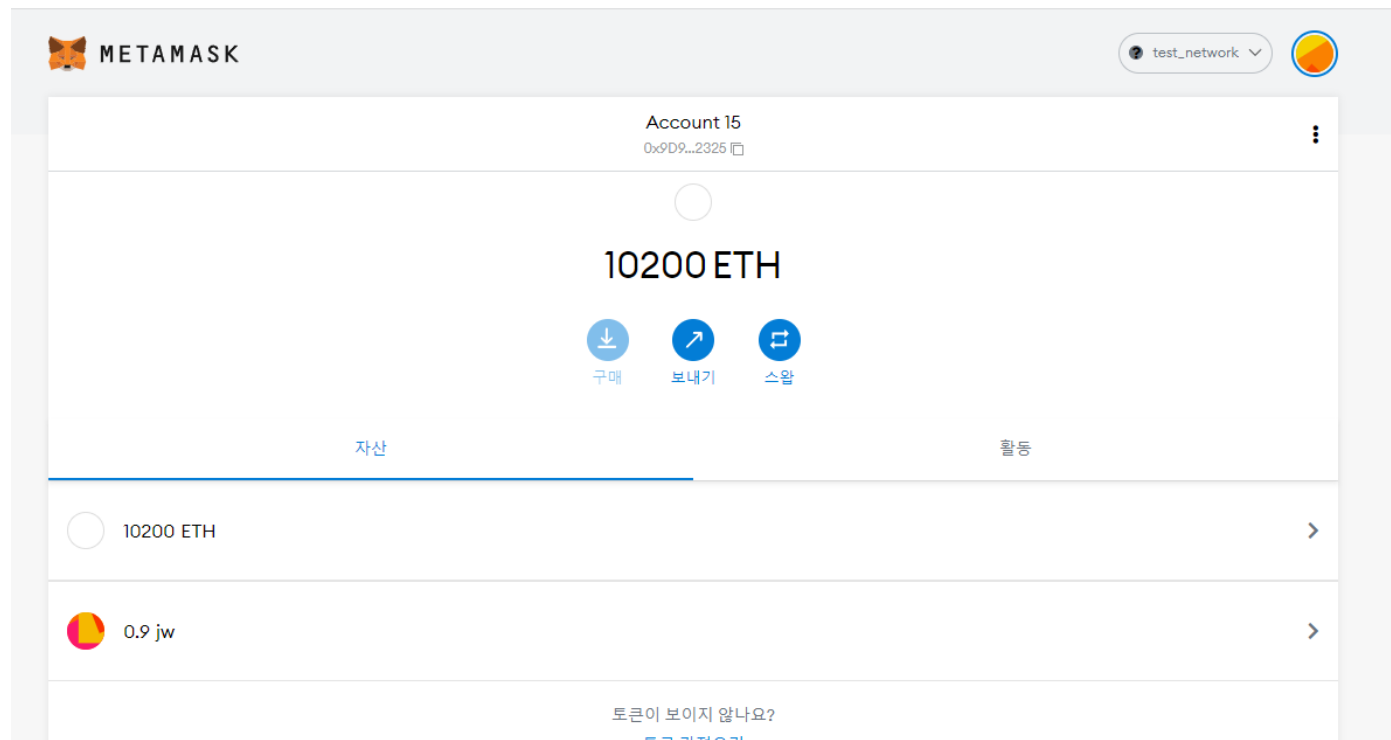
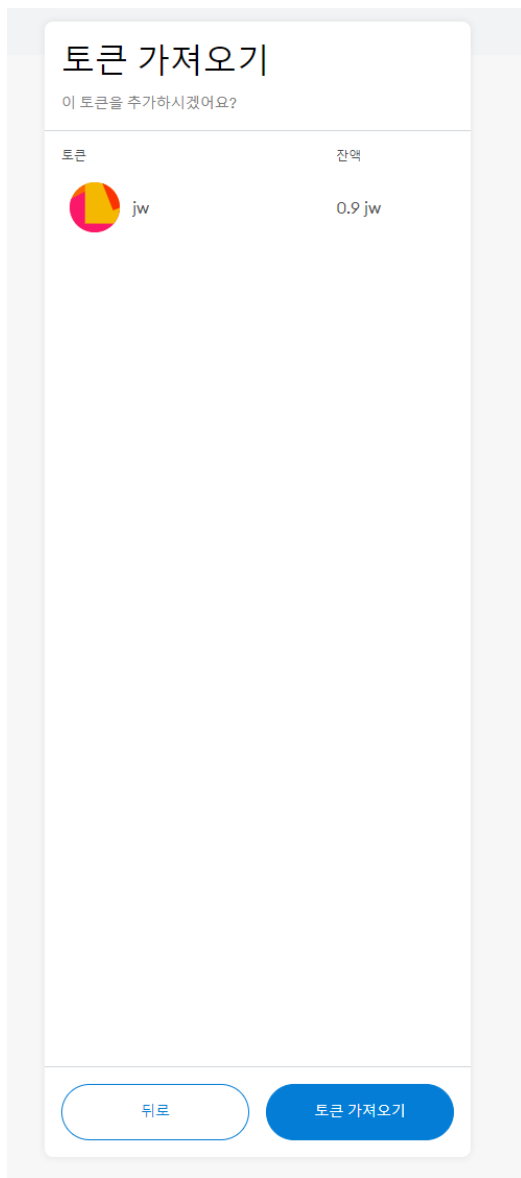
0: uint256: 9000000000000000000

Low level interactions ⓘ
CALLDATA

토큰 발행 실습



토큰 발행 실습



1. 실습 준비

- 1) 스마트 컨트랙트
- 2) 하이퍼렛저 베수 구동
- 3) Remix 활용
- 4) Web3 사용

2. 토큰 발행 실습

- 1) 토큰 발행 실습

3. 지갑 만들기

- 1) 지갑 만들기 실습

Nodejs 설치



```
system888@DESKTOP-GM35NPN MINGW64 /e/besu_privateNetwork/besu_wallet  
$ node -v  
v12.14.0
```


npm init

```
$ npm init
This utility will walk you through creating a package.json file.
It only covers the most common items, and tries to guess sensible defaults.


See `npm help json` for definitive documentation on these fields
and exactly what they do.

Use `npm install <pkg>` afterwards to install a package and
save it as a dependency in the package.json file.

Press ^C at any time to quit.
package name: (besu_wallet)
version: (1.0.0)
description:
entry point: (index.js)
test command:
git repository:
keywords:
author:
license: (ISC)
About to write to E:\besu_privateNetwork\besu_wallet\package.json:
{
  "name": "besu_wallet",
  "version": "1.0.0",
  "description": "",
  "main": "index.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "author": "",
  "license": "ISC"
}

Is this OK? (yes)
```

지갑 만들기 실습



The screenshot shows the Atom text editor with a file named `package.json` open. The file path in the title bar is `E:\besu_privateNetwork\besu_wallet`. The left sidebar shows the project structure with a folder named `besu_wallet` containing the `package.json` file. The main editor area displays the following JSON content:

```
1 {
2   "name": "besu_wallet",
3   "version": "1.0.0",
4   "description": "",
5   "main": "index.js",
6   "scripts": {
7     "test": "echo \"Error: no test specified\" && exit 1"
8   },
9   "author": "",
10  "license": "ISC"
11 }
12
```

npm install express npm install web3

```
system888@DESKTOP-QM35NPN MINGW64 /e/besu_privateNetwork/besu_wallet
$ npm install express
npm notice created a lockfile as package-lock.json. You should commit this file.
npm WARN besu_wallet@1.0.0 No description
npm WARN besu_wallet@1.0.0 No repository field.

+ express@4.17.3
added 50 packages from 37 contributors and audited 50 packages in 3.332s

1 package is looking for funding
  run `npm fund` for details

found 0 vulnerabilities

system888@DESKTOP-QM35NPN MINGW64 /e/besu_privateNetwork/besu_wallet
$ npm install web3
npm WARN deprecated request@2.88.2: request has been deprecated, see https://git
hub.com/request/request/issues/3142
npm WARN deprecated har-validator@5.1.5: this library is no longer supported
npm WARN deprecated multicodec@0.5.7: stable api reached

> bufferutil@4.0.6 install E:\besu_privateNetwork\besu_wallet\node_modules\buffe
rutil
> node-gyp-build

> secp256k1@4.0.3 install E:\besu_privateNetwork\besu_wallet\node_modules\secp25
6k1
> node-gyp-build || exit 0

> utf-8-validate@5.0.8 install E:\besu_privateNetwork\besu_wallet\node_modules\u
tf-8-validate
> node-gyp-build

> keccak@3.0.2 install E:\besu_privateNetwork\besu_wallet\node_modules\keccak
> node-gyp-build || exit 0

> web3-bzz@1.7.1 postinstall E:\besu_privateNetwork\besu_wallet\node_modules\web
3-bzz
> echo "WARNING: the web3-bzz api will be deprecated in the next version"
"WARNING: the web3-bzz api will be deprecated in the next version"

> web3-shh@1.7.1 postinstall E:\besu_privateNetwork\besu_wallet\node_modules\web
3-shh
> echo "WARNING: the web3-shh api will be deprecated in the next version"
"WARNING: the web3-shh api will be deprecated in the next version"

> web3@1.7.1 postinstall E:\besu_privateNetwork\besu_wallet\node_modules\web3
> echo "WARNING: the web3-shh and web3-bzz api will be deprecated in the next ve
rsion"
"WARNING: the web3-shh and web3-bzz api will be deprecated in the next version"

npm WARN besu_wallet@1.0.0 No description
npm WARN besu_wallet@1.0.0 No repository field.

+ web3@1.7.1
added 313 packages from 287 contributors and audited 363 packages in 26.807s

35 packages are looking for funding
  run `npm fund` for details

found 0 vulnerabilities
```

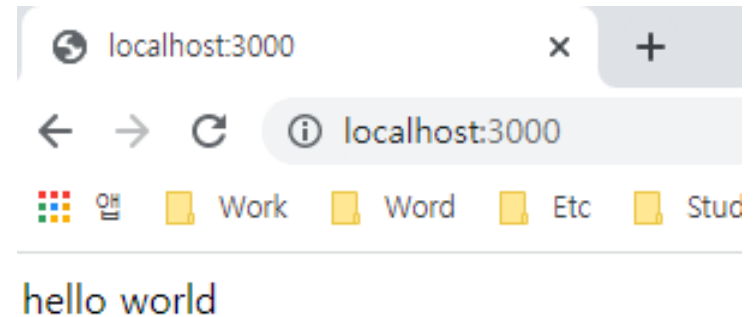
```
package.json
package-lock.json

1  {
2    "name": "besu_wallet",
3    "version": "1.0.0",
4    "description": "",
5    "main": "index.js",
6    "scripts": {
7      "test": "echo \"Error: no test specified\" && exit 1"
8    },
9    "author": "",
10   "license": "ISC",
11   "dependencies": {
12     "express": "^4.17.3",
13     "web3": "^1.7.1"
14   }
15 }
```

server.js 파일 생성 후 작성

```
server.js
1  var express = require('express');
2  var app = express();
3
4  var server = app.listen(3000, function(){
5    console.log("server is working now")
6  })
7
8  app.get('/', function(req, res){
9    res.send('hello world')
10 })
```

```
system888@DESKTOP-GM35NPN MINGW64 /e/besu_privateNetwork/besu_wallet
$ node server.js
server is working now
```



Html 페이지 만들기

```
package.json x
1 {
2   "name": "besu_wallet",
3   "version": "1.0.0",
4   "description": "",
5   "main": "index.js",
6   "scripts": {
7     "test": "echo \"Error: no test specified\" && exit 1"
8   },
9   "author": "",
10  "license": "ISC",
11  "dependencies": {
12    "express": "^4.17.3",
13    "web3": "^1.7.1",
14    "body-parser": "^1.19.0"
15  }
16 }
```

```
system888@DESKTOP-GM35NPN MINGW64 /e/besu_privateNetwork/besu_wallet
$ npm install
npm WARN besu_wallet@1.0.0 No description
npm WARN besu_wallet@1.0.0 No repository field.

audited 364 packages in 1.836s

35 packages are looking for funding
  run `npm fund` for details

found 0 vulnerabilities
```

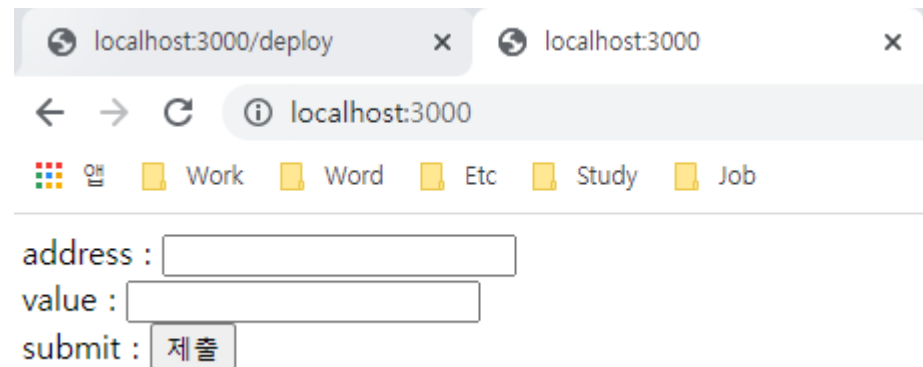
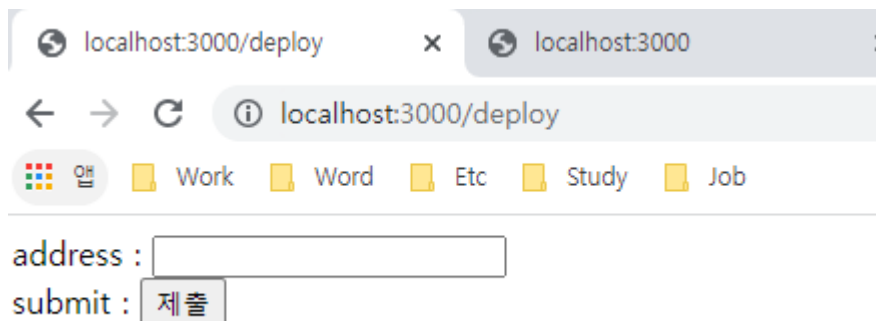
Html 페이지 만들기

```
1 var express = require('express');
2 var app = express();
3 var bodyParser = require('body-parser');
4
5 app.use(bodyParser.json())
6 app.use(bodyParser.urlencoded({ extended: true}));
7
8
9 app.get('/', function(req, res){
10   res.sendFile(__dirname+ "/index.html")
11 })
12
13 app.get('/deploy', function(req, res){
14   res.sendFile(__dirname+ "/deploy.html")
15 })
16
17 var server = app.listen(3000, function(){
18   console.log("server is working now")
19 })
```

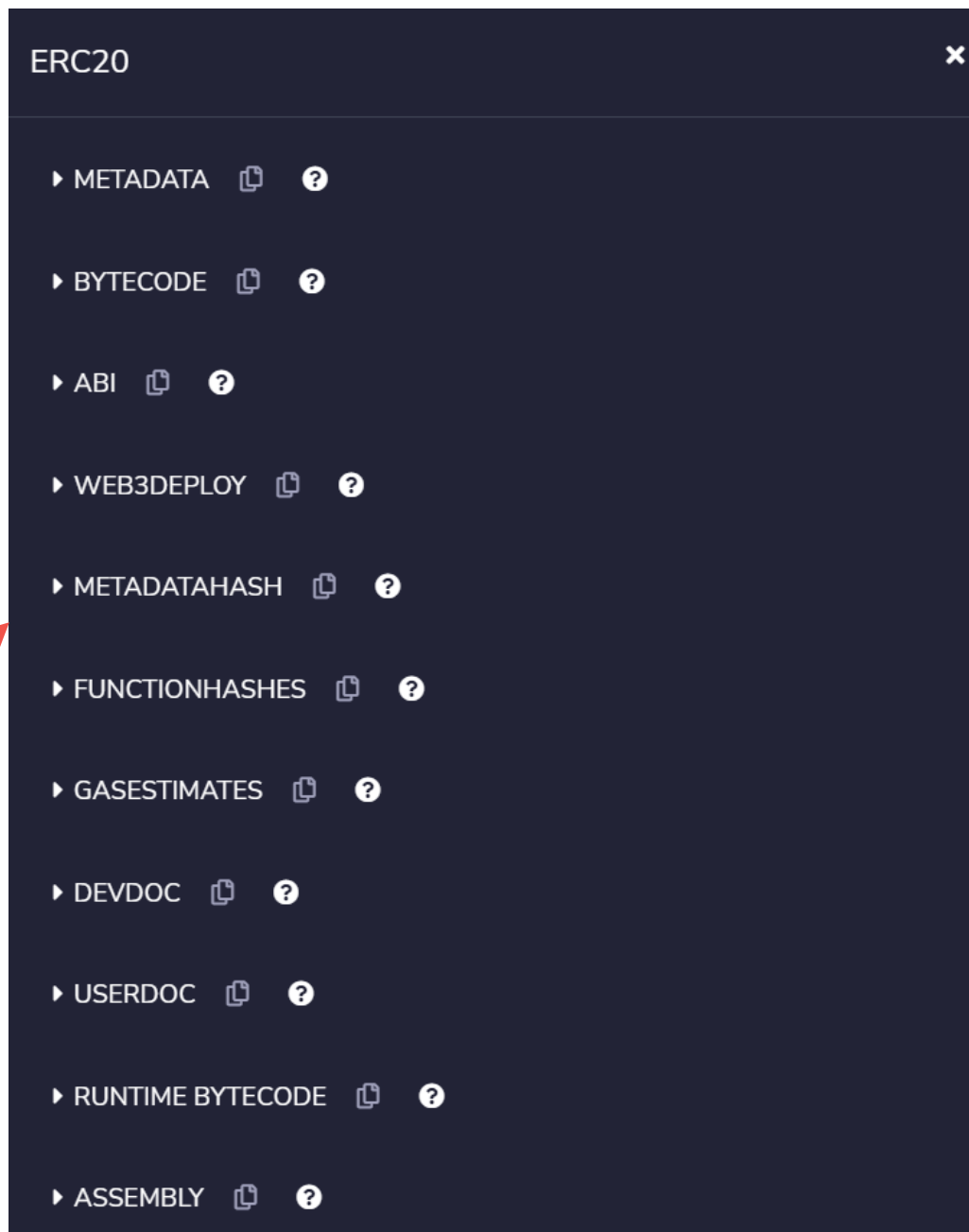
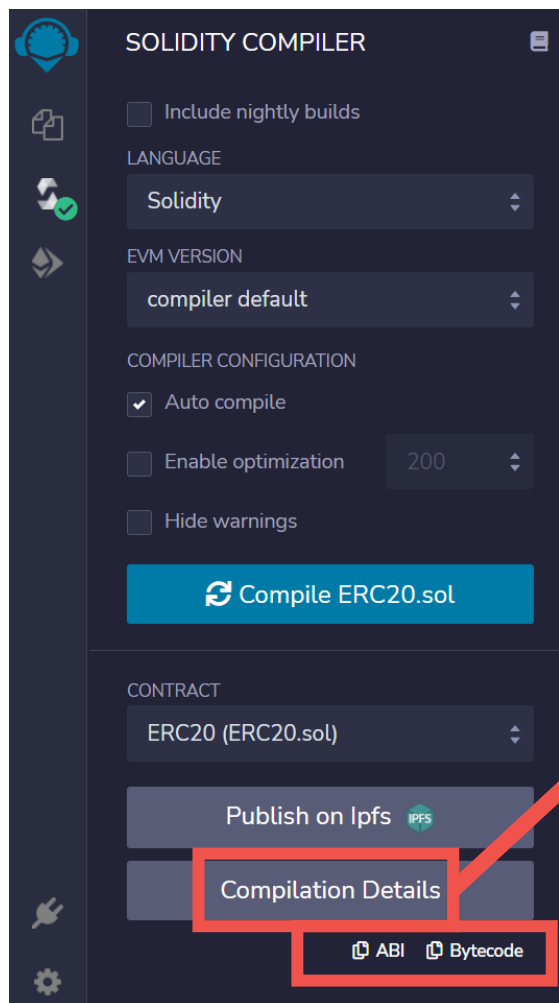
```
server.js  deploy.html  index.html
1 <form action="post" method="post">
2   address : <input type="text" name="address" /><br />
3   submit : <input type="submit" />
4 </form>
```

```
server.js  x  deploy.html  index.html
1 <form action="post" method="post">
2   address : <input type="text" name="address" /><br />
3   value : <input type="text" name="value" /> <br />
4   submit : <input type="submit" />
5 </form>
```

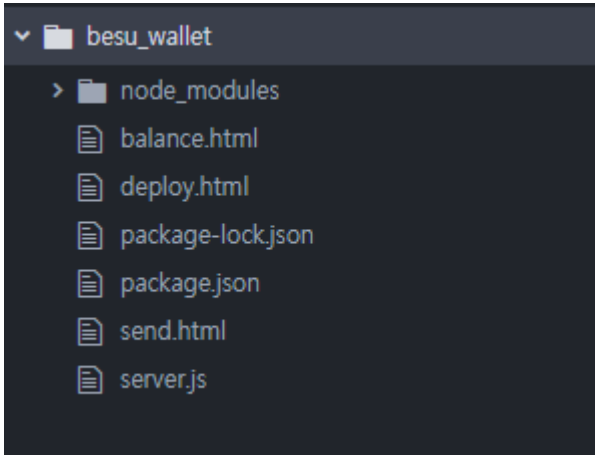
Html 페이지 만들기



지갑 만들기 실습



파일 및 package.json 내용



```
1  {
2    "name": "besu_wallet",
3    "version": "1.0.0",
4    "description": "",
5    "main": "index.js",
6    "scripts": {
7      "test": "echo \"Error: no test specified\" && exit 1"
8    },
9    "author": "",
10   "license": "ISC",
11   "dependencies": {
12     "express": "^4.17.3",
13     "web3": "^1.7.1",
14     "body-parser": "^1.19.0",
15     "ethereumjs-tx": "^1.3.7"
16   }
17 }
```

Html 파일

```
deploy.html x
1 <form action="/deploy" method="post">
2   token_name: <input type="text" name="tn" /><br />
3   token_symbol: <input type="text" name="ts" /><br />
4   total_supply: <input type="text" name="supply" /><br />
5   submit : <input type="submit" />
6 </form>
```

```
send.html x
1 <form action="/send" method="post">
2   address : <input type="text" name="address" /><br />
3   value : <input type="text" name="value" /> <br />
4   submit : <input type="submit" />
5 </form>
```

```
balance.html x
1 <form action="/balance" method="post">
2   address : <input type="text" name="address" /><br />
3   submit : <input type="submit" />
4 </form>
```

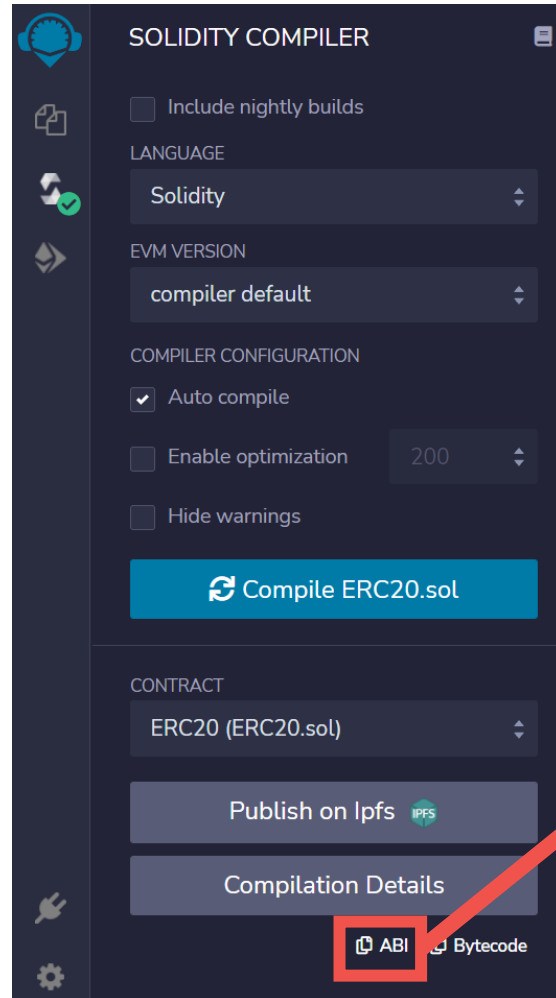
Server.js 파일

```
1 var express = require('express');
2 var app = express();
3 var bodyParser = require('body-parser');
4 var Web3 = require('web3');
5 var ethTx = require('ethereumjs-tx');
6
7 var web3 = new Web3(new Web3.providers.HttpProvider('http://127.0.0.1:8545'));
8
9 const address = '9D9a133eFE458949E30F6D4B184eD0CE11D02325';
10 const priv_key = Buffer.from('b628eda31d34b136633ff9d2b5177824569966560084768e0722df1e497ff773', 'hex');
```

Address 주소, 앞에 0x 제거

Private key 정보

Server.js 파일



복사

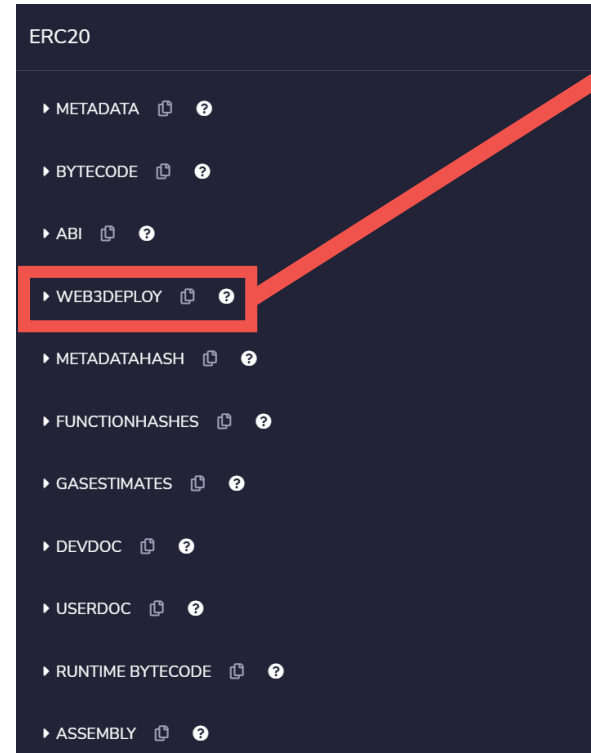
```
13 var ABI = [  
14   {  
15     "inputs": [  
16       {  
17         "internalType": "string",  
18         "name": "name_",  
19         "type": "string"  
20       },  
21       {  
22         "internalType": "string",  
23         "name": "symbol_",  
24         "type": "string"  
25       },  
26       {  
27         "internalType": "uint256",  
28         "name": "mint_",  
29         "type": "uint256"  
30       }  
31     ],  
32     "stateMutability": "nonpayable",  
33     "type": "constructor"  
34   },  
35   {  
36     "anonymous": false,  
37     "inputs": [  
38       {  
39         "indexed": true,  
40         "internalType": "address",  
41         "name": "owner",  
42         "type": "address"  
43       },  
44       {  
45         "indexed": true,  
46         "internalType": "address",  
47         "name": "spender",  
48         "type": "address"
```

지갑 만들기 실습

Server.js 파일

```
309 app.use(bodyParser.json())
310 app.use(bodyParser.urlencoded({ extended: true}));
311
312
313
314 v app.get('/deploy', function(req, res){
315     res.sendFile(__dirname+ "/deploy.html")
316 })
317
```

```
318 v app.post('/deploy', function(req, res){
319     var name_ = req.body.tn;
320     var symbol_ = req.body.ts ;
321     var mint_ = req.body.supply;
```



복사

```
var erc20Contract = new
web3.eth.Contract([{"inputs":[{"internalType":"string","n
pe":"uint256"}],"name":"Approval","type":"event"},{"anony
nternalType":"uint256","name":"","type":"uint256"}],"stat
pe":"uint256"}],"stateMutability":"view","type":"function
ype":"address","name":"spender","type":"address"},{"inter
"view","type":"function"},{"inputs":[],"name":"totalSuppl
nternalType":"address","name":"to","type":"address"},{"in

var erc20 = erc20Contract.deploy({
  data:
    '0x60806040523480156200001157600080fd5b506040516200194
fd5b6200010b60008383620001fd60201b60201c565b8060026000
36200020260201b60201c565b5050565b505050565b5050565b8
565b7f4e487b7100000000000000000000000000000000000000
d620003e7846200036a565b6200034b565b9050828152602081018
0162000421565b935050602084015167fffffffffffffffff811115
0000600052601160045260246000fd5b6000620005e8826200045
565b5b50919050565b61126880620006db6000396000f3fe608060
d565b610308565b6040516100f39190610c38565b6040518091039
9190610b22565b60405180910390f35b6102006004803603810190
16102fe565b820191906000526020600020905b815481529060010
fffffffffffffffffffffffffffffffffffffffff1681526020019081526020
00000000000000000081526004016104d390610ecc565b604051809
fffffffffffffffffffffffffffffffff168373fffffffffffffffffffffffff
fffffffffffffffffffffffffffffffff16815260200190815260200160002
6107f857818110156107ea576040517f08c379a0000000000000000
ffff1614156108de576040517f08c379a000000000000000000000000
fffffffffffffffffffffffffffffffff168152602001908152602001
00081519050919050565b600082825260208201905092915050565
69565b8114610b8f57600080fd5b50565b600081359050610ba181
15050565b60008060060608486031215610c9657610c95610b445
9050565b7f4e487b71000000000000000000000000000000000000
```

Server.js 파일

```
327     arguments: [  
328         name_,  
329         symbol_,  
330         mint_,  
331     ]  
332 })
```

```
333  
334     var set_string_byte_code = erc20.encodeABI();  
335  
336     web3.eth.getTransactionCount (address, "pending", (err, nonce) => {  
337         var Raw_Tx = {  
338             nonce: web3.utils.toHex(nonce),  
339             gasPrice: web3.utils.toHex(1000),  
340             gasLimit: web3.utils.toHex(3000000),  
341             data: set_string_byte_code,  
342             from: address  
343         };  
344  
345         var Signature = new Buffer.from(priv_key, "hex");  
346  
347         var Make_Tx = new ethTx(Raw_Tx);  
348         Make_Tx.sign(Signature);  
349  
350         var Serialized_Tx = Make_Tx.serialize();  
351         var Raw_Tx_Hex = '0x' + Serialized_Tx.toString('hex');  
352  
353         web3.eth.sendSignedTransaction(Raw_Tx_Hex).on('receipt', receipt => {  
354             console.log('receipt :', receipt);  
355         })  
356     })  
357  
358 })
```

Deploy 결과

[illegible]

×

토큰 가져오기

맞춤형 토큰

i

기존 토큰의 가짜 버전 생성을 포함하여 누구나 토큰을 생성할 수 있습니다. [사기 및 보안 위험](#)에 대해 자세히 알아보기

토큰 계약 주소

0x1f8890b3e32E25d5b8eC8d66BB2f0D828Fe9

토큰 기호

tx

토큰 십진수

18

맞춤형 토큰 추가

지갑 만들기 실습

Server.js 파일

```
360 app.get('/send', function(req, res){
361   res.sendFile(__dirname+ "/send.html")
362 })
363
364 app.post('/send', function(req, res){
365
366   var contract_address = "0x14B0Ce95857917aaB5Ab13aC6C0F7ec9fc611582";
367
368   var contract = new web3.eth.Contract(ABI, contract_address)
369
370   var set_contract = contract.methods.transfer(req.body.address, req.body.value);
371
372   var set_contract_byte = set_contract.encodeABI();
373
374   web3.eth.getTransactionCount (address, "pending", (err, nonce) => {
375     var Raw_Tx = {
376       nonce: web3.utils.toHex(nonce),
377       gasPrice: web3.utils.toHex(1000),
378       gasLimit: web3.utils.toHex(3000000),
379       data: set_contract_byte,
380       from: address,
381       to: contract_address
382     };
383   });
```

```
384   var Signature = new Buffer.from(priv_key, "hex");
385
386   var Make_Tx = new ethTx(Raw_Tx);
387   Make_Tx.sign(Signature);
388
389   var Serialized_Tx = Make_Tx.serialize();
390   var Raw_Tx_Hex = '0x' + Serialized_Tx.toString('hex');
391
392   web3.eth.sendSignedTransaction(Raw_Tx_Hex).on('receipt', receipt => {
393     console.log('receipt :', receipt);
394   })
395 })
396
397
398 })
```

Deploy 이후 나타나는 Smart Contract address

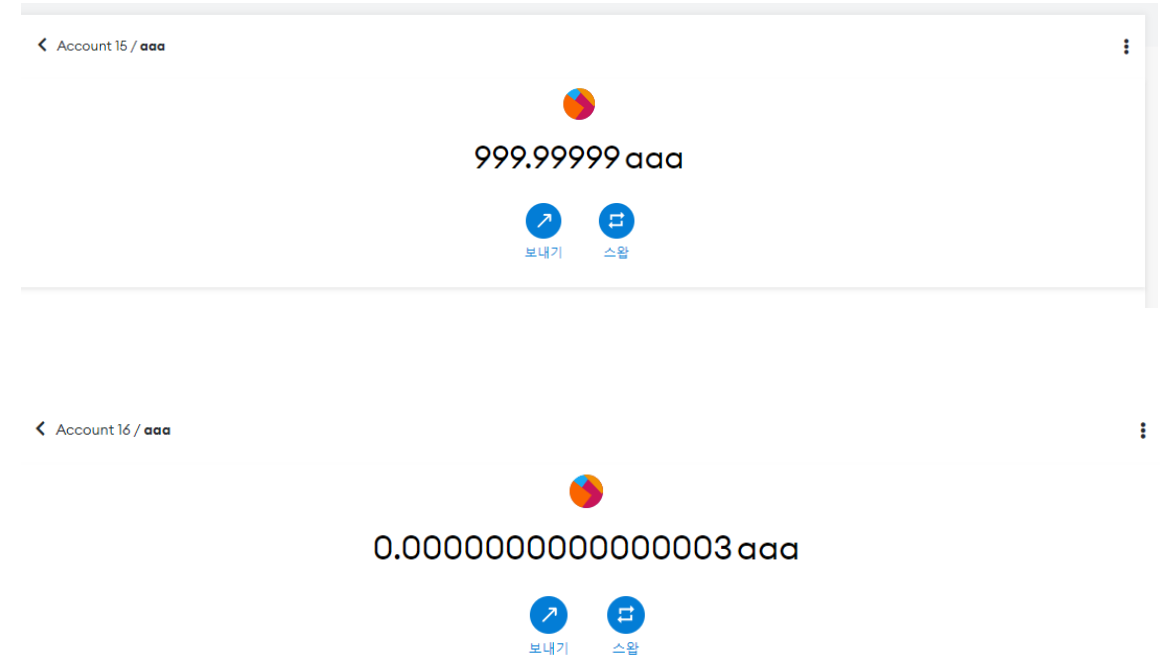
Server.js 파일

```
401 app.get('/balance', function(req, res){
402   res.sendFile(__dirname+"/balance.html")
403 })
404
405 app.post('/balance', function(req, res){
406   var contract_address = "0x14B0Ce95857917aaB5Ab13aC6C0F7ec9fC611582";
407   var contract = new web3.eth.Contract(ABI, contract_address);
408
409   contract.methods.balanceOf(req.body.address).call().then(data =>{
410
411     var decimal = Math.pow(10, 18)
412     var new_data = data / decimal
413
414     console.log(new_data);
415
416     res.send("balance= " +new_data)
417   })
418
419 })
420
421
422 var server = app.listen(3000, function(){
423   console.log("server is working now")
424 })
```

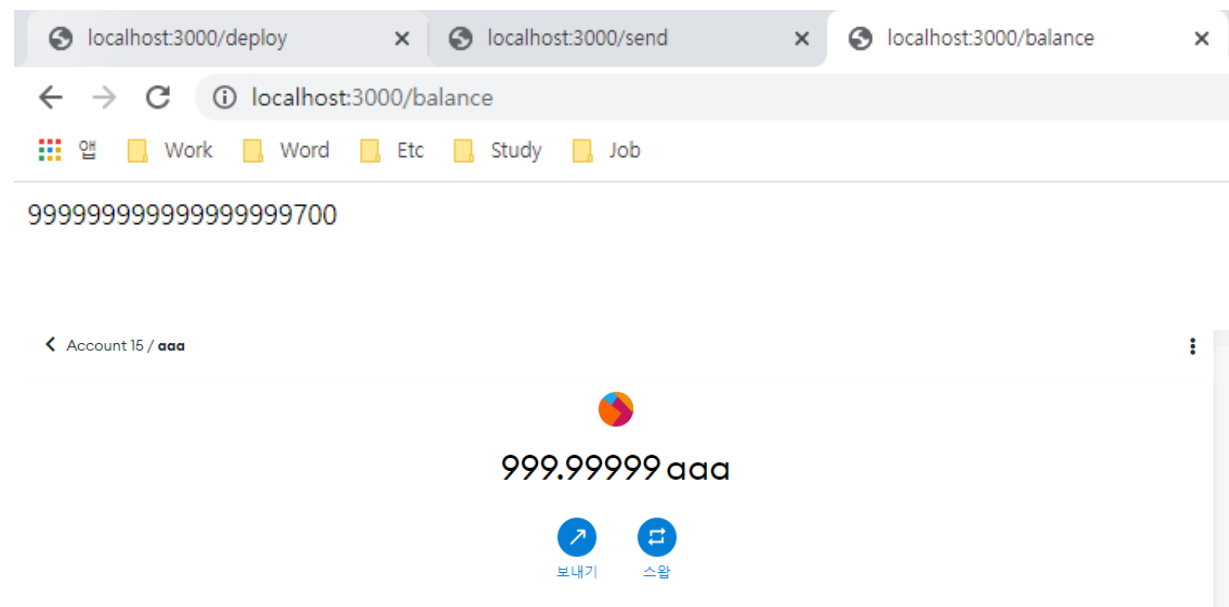
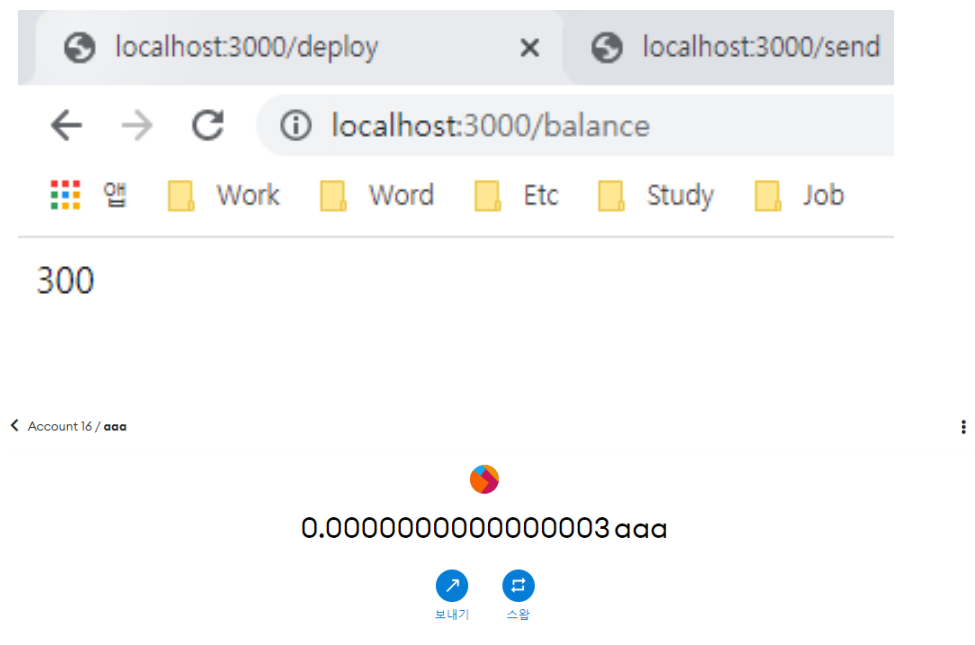
100%

[illegible]

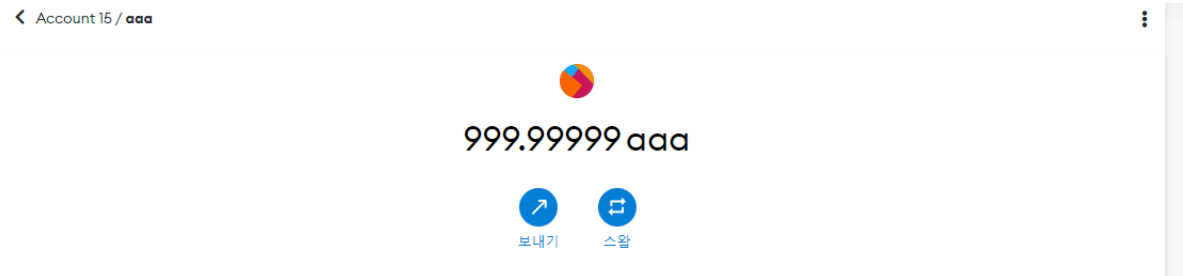
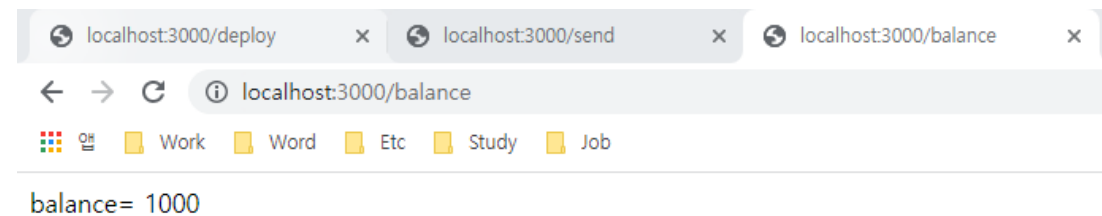
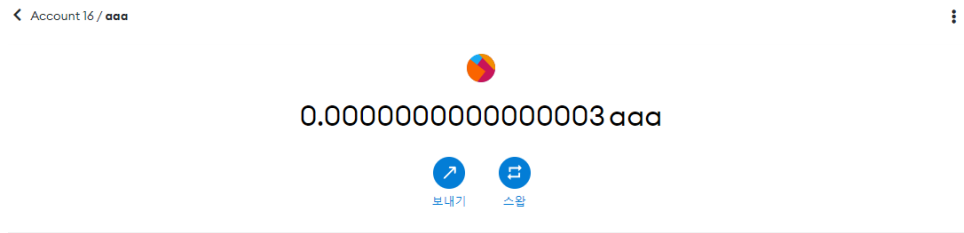
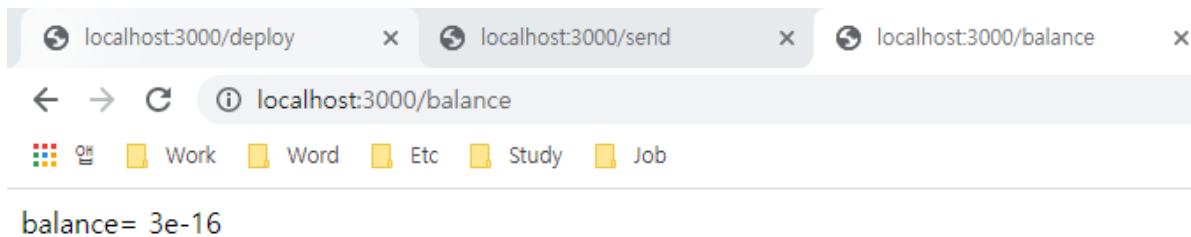
Send 결과



Balance 적용 완료 Decimal 적용 안된 상태



Decimal 적용



Decimal 해결법

```
var decimal = Math.pow(10, 18)
var new_data = data / decimal

console.log(new_data);

res.send("balance= " +new_data)
})
```

Nodejs 상에서 수식 Decimal 만큼 수식 적용

```
function decimals() public view virtual override returns (uint8) {
    return 18;
}
```

Smart contract상의 decimals 함수의 return 값
변경후 재 배포

Q & A

