实验4 Fabric 开发并部署链码

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实验目的以及要求

- 了解fabric上的链码部署和配置
- 开发fabric上的链码
- 实现一个fabric上的链码和功能

实验平台

- Windows 10 professional
- ubuntu虚拟机（ssh远程连接，配备有注册好的ca服务器）

实验步骤

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链码打包

首先是链码打包，进入bash，执行如下指令：

```
peer lifecycle chaincode package fabcar.tar.gz \
>  --path go/src/etc/hyperledger/org1/go --lang golang --label fabcar_1
```

上述路径为本地提前挂载好的路径

看到如下信息表示打包完成：

```
l fabcar_1
2022-06-27 08:13:34.854 UTC [bccsp] GetDefault -> DEBU 001 Before using BCCSP, please call InitFactories(). Falling back to
bootBCCSP.
2022-06-27 08:13:34.920 UTC [bccsp] GetDefault -> DEBU 002 Before using BCCSP, please call InitFactories(). Falling back to
bootBCCSP.
2022-06-27 08:13:34.926 UTC [main] InitCmd -> DEBU 003 peer lifecycle chaincode package does not need to init crypto
2022-06-27 08:14:15.364 UTC [chaincode.platform.util] WriteFileToPackage -> DEBU 004 Writing file to tarball: src/fabcar.go
2022-06-27 08:14:15.446 UTC [chaincode.platform.util] WriteFileToPackage -> DEBU 005 Writing file to tarball: src/go.mod
2022-06-27 08:14:15.450 UTC [chaincode.platform.util] WriteFileToPackage -> DEBU 006 Writing file to tarball: src/go.sum
bash-5.0# ls
fabcar.go      fabcar.tar.gz  go.mod         go.sum
```

链码安装

打包完成之后执行如下指令，进行链码安装：

```
//使用admin的证书来进行链码安装操作
export CORE_PEER_MSPCONFIGPATH=/etc/hyperledger/org1/admin/msp
//安装链码
peer lifecycle chaincode install fabcar.tar.gz
//查询安装的链码
peer lifecycle chaincode queryinstalled
```

安装完成后提示如下信息，显示链码已经上链

```
2022-06-27 08:28:07.608 UTC [msp.identity] Sign -> DEBU 032 Sign: plaintext: 0AD9080A6208031A0C0897D4E5950610...6C6C65644368
61696E636F6465730A00
2022-06-27 08:28:07.610 UTC [msp.identity] Sign -> DEBU 033 Sign: digest: 0CDDB8B9DFA2D5D2AEA47629771B0F2C2254A7A49969641CF7
4E8E4433170AE0
Installed chaincodes on peer:
Package ID: fabcar_1:7b0ab52f7dd7a3b34d7f9a3461897f70accd0f9b8d604e6a4518e72ee2e86c55, Label: fabcar_1
```

链码准入

安装完成后执行如下指令，即可实现链码准入。

```
export CORE_PEER_MSPCONFIGPATH=/etc/hyperledger/org1/admin/msp
peer lifecycle chaincode queryinstalled

export VERSION=60
export
PACKAGE_ID=fabcar_1:7b0ab52f7dd7a3b34d7f9a3461897f70accd0f9b8d604e6a4518e72ee2e86c
55
// tls证书
export ORDERER_CA=/etc/hyperledger/org1/peer2/tls-msp/tlscacerts/tls-172-16-4-35-
7052.pem
export CHANNEL_NAME=mychannel

peer lifecycle chaincode approveformyorg -o orderer1-org0:7050 --
ordererTLSHostnameOverride orderer1-org0 --tls --cafile ${ORDERER_CA} --channelID
${CHANNEL_NAME} --name fabcar --version ${VERSION} --package-id ${PACKAGE_ID} --
sequence ${VERSION}
```

其中version要注意比现有链的数量要大

准入成功后得出以下提示：

```
FFFFFFFFFFFFFFFFF01
2022-06-27 08:33:58.854 UTC [msp.identity] Sign -> DEBU 044 Sign: digest: 0E4B169FA60CE9F76537328522BC5E03A953145A7674DA5FCC
08AA41B79A7BB3
2022-06-27 08:34:01.855 UTC [chaincodeCmd] ClientWait -> INFO 045 txid [ebc7d429a729540c3233f4403227367dc9ddf2c20478a237b9e9
ee8ebfe6d657] committed with status (VALID) at
```

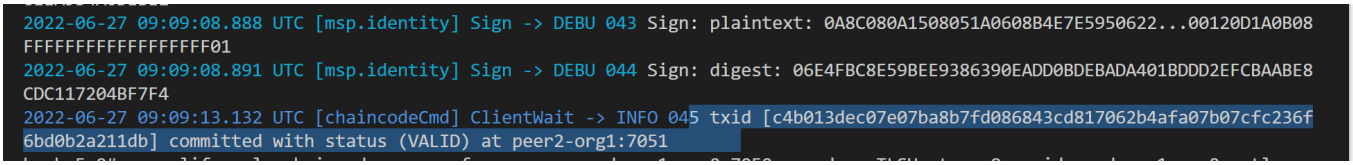
链码上链

利用如下指令进行链码上链操作

```
peer lifecycle chaincode commit -o orderer1-org0:7050 --ordererTLSHostnameOverride
orderer1-org0 --tls --cafile $ORDERER_CA --channelID $CHANNEL_NAME --name fabcar -
-peerAddresses PB20000024_v2:7051 --tlsRootCertFiles ${ORDERER_CA}  --version
${VERSION} --sequence ${VERSION}
```

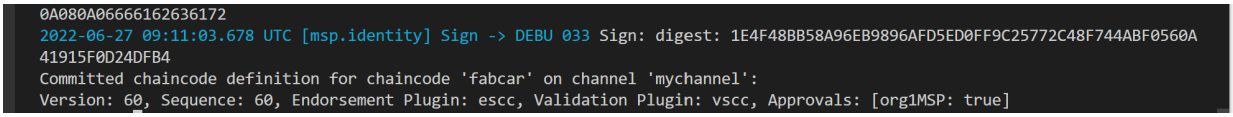
环境变量同上，但是顺序要按照块数量进行指定

上链成功之后得到以下提示：



之后运行

```
peer lifecycle chaincode querycommitted --channelID mychannel --name fabcar
```

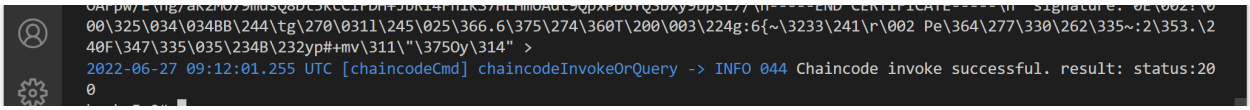


可以看到提交已经成功

再运行

```
peer chaincode invoke -o orderer1-org0:7050 --ordererTLSHostnameOverride orderer1-
org0 --tls --cafile $ORDERER_CA -C $CHANNEL_NAME -n fabcar --peerAddresses peer1-
org1:7051 --tlsRootCertFiles ${ORDERER_CA}  -c '{"function":"initLedger","Args":
[]}'
```

能够看到已经成功初始化



B档

添加新节点

源码如下：

```
// CreateCar adds a new car to the world state with given details
func (s *SmartContract) CreateCar(ctx contractapi.TransactionContextInterface,
carNumber string, make string, model string, colour string, owner string) error {
        car := Car{
```

```
                Make:   make,
                Model:  model,
                Colour: colour,
                Owner:  owner,
        }

        carAsBytes, _ := json.Marshal(car)

        return ctx.GetStub().PutState(carNumber, carAsBytes)
}
```

执行如下指令：

```
bash-5.0# peer chaincode invoke -o orderer1-org0:7050 --ordererTLSHostnameOverride orderer1-org0 --tls --cafile $ORDERER_CA
-C $CHANNEL_NAME -n fabcar --peerAddresses PB20000024_v2:7051 --tlsRootCertFiles ${ORDERER_CA}  -c '{"function":"CreateCar",
"Args":["PB20000024","potato","toamto","carrot","cherry"]}'
```

得到如下结果：

```
FB26AEB47EDBDA
[{"Key":"ARC12","Record":{"make":"ZCXY","model":"XX","colour":"white","owner":"Cxy"}},{"Key":"CAR0","Record":{"make":"Toyota
","model":"Prius","colour":"blue","owner":"Tomoko"}},{"Key":"CAR1","Record":{"make":"Ford","model":"Mustang","colour":"red",
"owner":"Brad"}},{"Key":"CAR10","Record":{"make":"lh","model":"lh","colour":"lh","owner":"lh"}},{"Key":"CAR11","Record":{"ma
ke":"ACXY","model":"XX","colour":"white","owner":"Cxy"}},{"Key":"CAR2","Record":{"make":"Hyundai","model":"Tucson","colour":
"green","owner":"Jin Soo"}},{"Key":"CAR3","Record":{"make":"Volkswagen","model":"Passat","colour":"yellow","owner":"Max"}},{
"Key":"CAR4","Record":{"make":"Tesla","model":"S","colour":"black","owner":"Adriana"}},{"Key":"CAR5","Record":{"make":"Peuge
ot","model":"205","colour":"purple","owner":"Michel"}},{"Key":"CAR6","Record":{"make":"Chery","model":"S22L","colour":"white
","owner":"Aarav"}},{"Key":"CAR7","Record":{"make":"Fiat","model":"Punto","colour":"violet","owner":"Pari"}},{"Key":"CAR8","
Record":{"make":"Tata","model":"Nano","colour":"indigo","owner":"Valeria"}},{"Key":"CAR9","Record":{"make":"Holden","model":
"Barina","colour":"brown","owner":"Shotaro"}},{"Key":"CAR99","Record":{"make":"ZCXY","model":"XX","colour":"white","owner":"
Cxy"}},{"Key":"PB19000046","Record":{"make":"make","model":"model","colour":"blue","owner":"yyc"}},{"Key":"PB19000046-2","Re
cord":{"make":"make","model":"model","colour":"blue","owner":"yyc"}},{"Key":"PB19000071","Record":{"make":"PengYiTeng","mode
l":"BlockChain","colour":"lab4","owner":"Modify"}},{"Key":"PB19000078","Record":{"make":"abc","model":"acb","colour":"green"
,"owner":"wangzhen0000"}},{"Key":"PB20000024","Record":{"make":"potato","model":"toamto","colour":"carrot","owner":"cherry"}
},{"Key":"PB20000025","Record":{"make":"sn2","model":"201","colour":"blue","owner":"cckk"}},{"Key":"ZYM","Record":{"make":"z
ym","model":"zym","colour":"zym","owner":"zym"}}]
```

说明添加成功

查询节点

源码如下：

```
func (s *SmartContract) QueryCar(ctx contractapi.TransactionContextInterface,
carNumber string) (*Car, error) {
    carAsBytes, err := ctx.GetStub().GetState(carNumber)

    if err != nil {
        return nil, fmt.Errorf("Failed to read from world state. %s", err.Error())
    }

    if carAsBytes == nil {
        return nil, fmt.Errorf("%s does not exist", carNumber)
    }

    car := new(Car)
    _ = json.Unmarshal(carAsBytes, car)
```

```
        return car, nil
    }
```

执行如下指令：

```
bash-5.0# peer chaincode invoke -o orderer1-org0:7050 --ordererTLSHostnameOverride orderer1-org0 --tls --cafile $ORDERER_CA
-C $CHANNEL_NAME -n fabcar --peerAddresses PB20000024_v2:7051 --tlsRootCertFiles ${ORDERER_CA}  -c '{"function":"QueryCar","
Args":["PB20000024","potato","toamto","carrot","cherry"]}'
```

得到查询结果

```
7_\352#\013\002.\227z\367f\344" >
2022-06-30 03:32:41.617 UTC [chaincodeCmd] chaincodeInvokeOrQuery -> INFO 044 Chaincode invoke successful. result: status:20
0 payload:"{\"make\":\"potato\",\"model\":\"toamto\",\"colour\":\"carrot\",\"owner\":\"cherry\"}"
bash-5.0#
```

删除节点

源码如下：

```
func (s *SmartContract) DeleteCar(ctx contractapi.TransactionContextInterface,
carNumber string) (*Car, error) {
    carAsBytes, err := ctx.GetStub().GetState(carNumber)

    if err != nil {
        return nil, fmt.Errorf("Failed to read from world state. %s", err.Error())
    }

    if carAsBytes == nil {
        return nil, fmt.Errorf("%s does not exist", carNumber)
    }

    return nil, ctx.GetStub().DelState(carNumber)

}
```

执行如下指令：

```
bash-5.0# peer chaincode invoke -o orderer1-org0:7050 --ordererTLSHostnameOverride orderer1-org0 --tls --cafile $ORDERER_CA
-C $CHANNEL_NAME -n fabcar --peerAddresses PB20000024_v2:7051 --tlsRootCertFiles ${ORDERER_CA}  -c '{"function":"DeleteCar",
"Args":["PB20000024","potato","toamto","carrot","cherry"]}'
```

之后再查询资产，可以看到：

```
13F8A0F3E59931
[{"Key":"ARC12","Record":{"make":"ZCXY","model":"XX","colour":"white","owner":"Cxy"}},{"Key":"CAR0","Record":{"make":"Toyota
","model":"Prius","colour":"blue","owner":"Tomoko"}},{"Key":"CAR1","Record":{"make":"Ford","model":"Mustang","colour":"red",
"owner":"Brad"}},{"Key":"CAR10","Record":{"make":"lh","model":"lh","colour":"lh","owner":"lh"}},{"Key":"CAR11","Record":{"ma
ke":"ACXY","model":"XX","colour":"white","owner":"Cxy"}},{"Key":"CAR2","Record":{"make":"Hyundai","model":"Tucson","colour":
"green","owner":"Jin Soo"}},{"Key":"CAR3","Record":{"make":"Volkswagen","model":"Passat","colour":"yellow","owner":"Max"}},{
"Key":"CAR4","Record":{"make":"Tesla","model":"S","colour":"black","owner":"Adriana"}},{"Key":"CAR5","Record":{"make":"Peuge
ot","model":"205","colour":"purple","owner":"Michel"}},{"Key":"CAR6","Record":{"make":"Chery","model":"S22L","colour":"white
","owner":"Aarav"}},{"Key":"CAR7","Record":{"make":"Fiat","model":"Punto","colour":"violet","owner":"Pari"}},{"Key":"CAR8","
Record":{"make":"Tata","model":"Nano","colour":"indigo","owner":"Valeria"}},{"Key":"CAR9","Record":{"make":"Holden","model":
"Barina","colour":"brown","owner":"Shotaro"}},{"Key":"CAR99","Record":{"make":"ZCXY","model":"XX","colour":"white","owner":"
Cxy"}},{"Key":"PB19000046","Record":{"make":"make","model":"model","colour":"blue","owner":"yyc"}},{"Key":"PB19000046-2","Re
cord":{"make":"make","model":"model","colour":"blue","owner":"yyc"}},{"Key":"PB19000071","Record":{"make":"PengYiTeng","mode
l":"BlockChain","colour":"Lab4","owner":"Modify"}},{"Key":"PB19000078","Record":{"make":"abc","model":"acb","colour":"green"
,"owner":"wangzhen0000"}},{"Key":"PB20000025","Record":{"make":"shz","model":"201","colour":"blue","owner":"cckk"}},{"Key":"
ZYM","Record":{"make":"zym","model":"zym","colour":"zym","owner":"zym"}}]
```

资产已经成功被删除

修改节点

源码如下：

```
func (s *SmartContract) ChangeCar(ctx contractapi.TransactionContextInterface,
carNumber string, make string, model string, colour string, owner string) error {
    car, err := s.QueryCar(ctx, carNumber)

    if err != nil {
        return nil
    }

    car.Make = make
    car.Owner = owner
    car.Colour = colour
    car.Model = model

    carAsBytes, _ := json.Marshal(car)

    return ctx.GetStub().PutState(carNumber, carAsBytes)
}
```

执行如下指令：

```
bash-5.0# peer chaincode invoke -o orderer1-org0:7050 --ordererTLSHostnameOverride orderer1-org0 --tls --cafile $ORDERER_CA
-C $CHANNEL_NAME -n fabcar --peerAddresses PB20000024_v2:7051 --tlsRootCertFiles ${ORDERER_CA}  -c '{"function":"ChangeCar",
"Args":["PB20000025","potato","toamto","carrot","cherry"]}'
```

之后查询资产，可以发现修改已经产生：

```
[{"Key":"ARC12","Record":{"make":"ZCXY","model":"XX","colour":"white","owner":"Cxy"}},{"Key":"CAR0","Record":{"make":"Toyota
","model":"Prius","colour":"blue","owner":"Tomoko"}},{"Key":"CAR1","Record":{"make":"Ford","model":"Mustang","colour":"red",
"owner":"Brad"}},{"Key":"CAR10","Record":{"make":"lh","model":"lh","colour":"lh","owner":"lh"}},{"Key":"CAR11","Record":{"ma
ke":"ACXY","model":"XX","colour":"white","owner":"Cxy"}},{"Key":"CAR2","Record":{"make":"Hyundai","model":"Tucson","colour":
"green","owner":"Jin Soo"}},{"Key":"CAR3","Record":{"make":"Volkswagen","model":"Passat","colour":"yellow","owner":"Max"}},{
"Key":"CAR4","Record":{"make":"Tesla","model":"S","colour":"black","owner":"Adriana"}},{"Key":"CAR5","Record":{"make":"Peuge
ot","model":"205","colour":"purple","owner":"Michel"}},{"Key":"CAR6","Record":{"make":"Chery","model":"S22L","colour":"white
","owner":"Aarav"}},{"Key":"CAR7","Record":{"make":"Fiat","model":"Punto","colour":"violet","owner":"Pari"}},{"Key":"CAR8","
Record":{"make":"Tata","model":"Nano","colour":"indigo","owner":"Valeria"}},{"Key":"CAR9","Record":{"make":"Holden","model":
"Barina","colour":"brown","owner":"Shotaro"}},{"Key":"CAR99","Record":{"make":"ZCXY","model":"XX","colour":"white","owner":"
Cxy"}},{"Key":"PB19000046","Record":{"make":"make","model":"model","colour":"blue","owner":"yyc"}},{"Key":"PB19000046-2","Re
cord":{"make":"make","model":"model","colour":"blue","owner":"yyc"}},{"Key":"PB19000071","Record":{"make":"PengYiTeng","mode
l":"BlockChain","colour":"Lab4","owner":"Modify"}},{"Key":"PB19000078","Record":{"make":"abc","model":"acb","colour":"green"
,"owner":"wangzhen0000"}},{"Key":"PB20000025","Record":{"make":"potato","model":"toamto","colour":"carrot","owner":"cherry"}
},{"Key":"ZYM","Record":{"make":"zym","model":"zym","colour":"zym","owner":"zym"}}]
```

B档所有操作已经完毕

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这里添加的额外指令是sort排序指令

源码如下：

```
func (s res) Len() int {
    return len(s)
}
func (s res) Swap(i, j int) {
    s[i], s[j] = s[j], s[i]
}
func (s res) Less(i, j int) bool {
    return strings.Compare(s[i].Record.Owner, s[j].Record.Owner) == 1
}

func (s *SmartContract) SortCar(ctx contractapi.TransactionContextInterface)
([]*QueryResult, error) {
    startKey := ""
    endKey := ""

    resultsIterator, err := ctx.GetStub().GetStateByRange(startKey, endKey)

    if err != nil {
        return nil, nil
    }
    defer resultsIterator.Close()

    results := []*QueryResult{}

    for resultsIterator.HasNext() {
        queryResponse, err := resultsIterator.Next()

        if err != nil {
            return nil, nil
        }

        car := new(Car)
        _ = json.Unmarshal(queryResponse.Value, car)

        queryResult := QueryResult{Key: queryResponse.Key, Record: car}
        results = append(results, &queryResult)
    }
    sort.Sort(res(results))

    return results, nil
}
```

执行如下指令：

```
bash-5.0# peer chaincode invoke -o orderer1-org0:7050 --ordererTLSHostnameOverride orderer1-org0 --tls --cafile $ORDERER_CA
-C $CHANNEL_NAME -n fabcar --peerAddresses PB20000024_v2:7051 --tlsRootCertFiles ${ORDERER_CA}  -c '{"function":"SortCar","A
rgs":[]}'
```

可以看到降序排列的交易列表：

```
2022-06-30 03:47:37.226 UTC [chaincodeCmd] chaincodeInvokeOrQuery -> INFO 044 Chaincode invoke successful. result: status:200 payload:"[{\"Key\":\"ZYM\",\"Record\":{\"make\":\"zym\",\"model\":\"zym\",\"colour\":\"zym\",\"owner\":\"zym\"}},{\"Key\":\"PB20000025\",\"Record\":{\"make\":\"potato\",\"model\":\"toamto\",\"colour\":\"carrot\",\"owner\":\"cherry\"}},{\"Key\":\"PB19000078\",\"Record\":{\"make\":\"abc\",\"model\":\"acb\",\"colour\":\"green\",\"owner\":\"wangzhen0000\"}},{\"Key\":\"PB19000071\",\"Record\":{\"make\":\"PengYiTeng\",\"model\":\"BlockChain\",\"colour\":\"Lab4\",\"owner\":\"Modify\"}},{\"Key\":\"PB19000046-2\",\"Record\":{\"make\":\"make\",\"model\":\"model\",\"colour\":\"blue\",\"owner\":\"yyc\"}},{\"Key\":\"PB19000046\",\"Record\":{\"make\":\"make\",\"model\":\"model\",\"colour\":\"blue\",\"owner\":\"yyc\"}},{\"Key\":\"CAR99\",\"Record\":{\"make\":\"ZCXY\",\"model\":\"XX\",\"colour\":\"white\",\"owner\":\"Cxy\"}},{\"Key\":\"CAR9\",\"Record\":{\"make\":\"Holden\",\"model\":\"Barina\",\"colour\":\"brown\",\"owner\":\"Shotaro\"}},{\"Key\":\"CAR8\",\"Record\":{\"make\":\"Tata\",\"model\":\"Nano\",\"colour\":\"indigo\",\"owner\":\"Valeria\"}},{\"Key\":\"CAR7\",\"Record\":{\"make\":\"Fiat\",\"model\":\"Punto\",\"colour\":\"violet\",\"owner\":\"Pari\"}},{\"Key\":\"CAR6\",\"Record\":{\"make\":\"Chery\",\"model\":\"S22L\",\"colour\":\"white\",\"owner\":\"Aarav\"}},{\"Key\":\"CAR5\",\"Record\":{\"make\":\"Peugeot\",\"model\":\"205\",\"colour\":\"purple\",\"owner\":\"Michel\"}},{\"Key\":\"CAR4\",\"Record\":{\"make\":\"Tesla\",\"model\":\"S\",\"colour\":\"black\",\"owner\":\"Adriana\"}},{\"Key\":\"CAR3\",\"Record\":{\"make\":\"Volkswagen\",\"model\":\"Passat\",\"colour\":\"yellow\",\"owner\":\"Max\"}},{\"Key\":\"CAR2\",\"Record\":{\"make\":\"Hyundai\",\"model\":\"Tucson\",\"colour\":\"green\",\"owner\":\"Jin Soo\"}},{\"Key\":\"CAR11\",\"Record\":{\"make\":\"ACXY\",\"model\":\"XX\",\"colour\":\"white\",\"owner\":\"Cxy\"}},{\"Key\":\"CAR10\",\"Record\":{\"make\":\"lh\",\"model\":\"lh\",\"colour\":\"lh\",\"owner\":\"lh\"}},{\"Key\":\"CAR1\",\"Record\":{\"make\":\"Ford\",\"model\":\"Mustang\",\"colour\":\"red\",\"owner\":\"Brad\"}},{\"Key\":\"CAR0\",\"Record\":{\"make\":\"Toyota\",\"model\":\"Prius\",\"colour\":\"blue\",\"owner\":\"Tomoko\"}},{\"Key\":\"ARC12\",\"Record\":{\"make\":\"ZCXY\",\"model\":\"XX\",\"colour\":\"white\",\"owner\":\"Cxy\"}}]"
```

排列成功

实验总结

本实验中，我学习到了简单的链码配置以及链码的修改，进一步理解了超级账本和链码的功能，并且也学习到了很多远程操作的办法，收获颇丰。