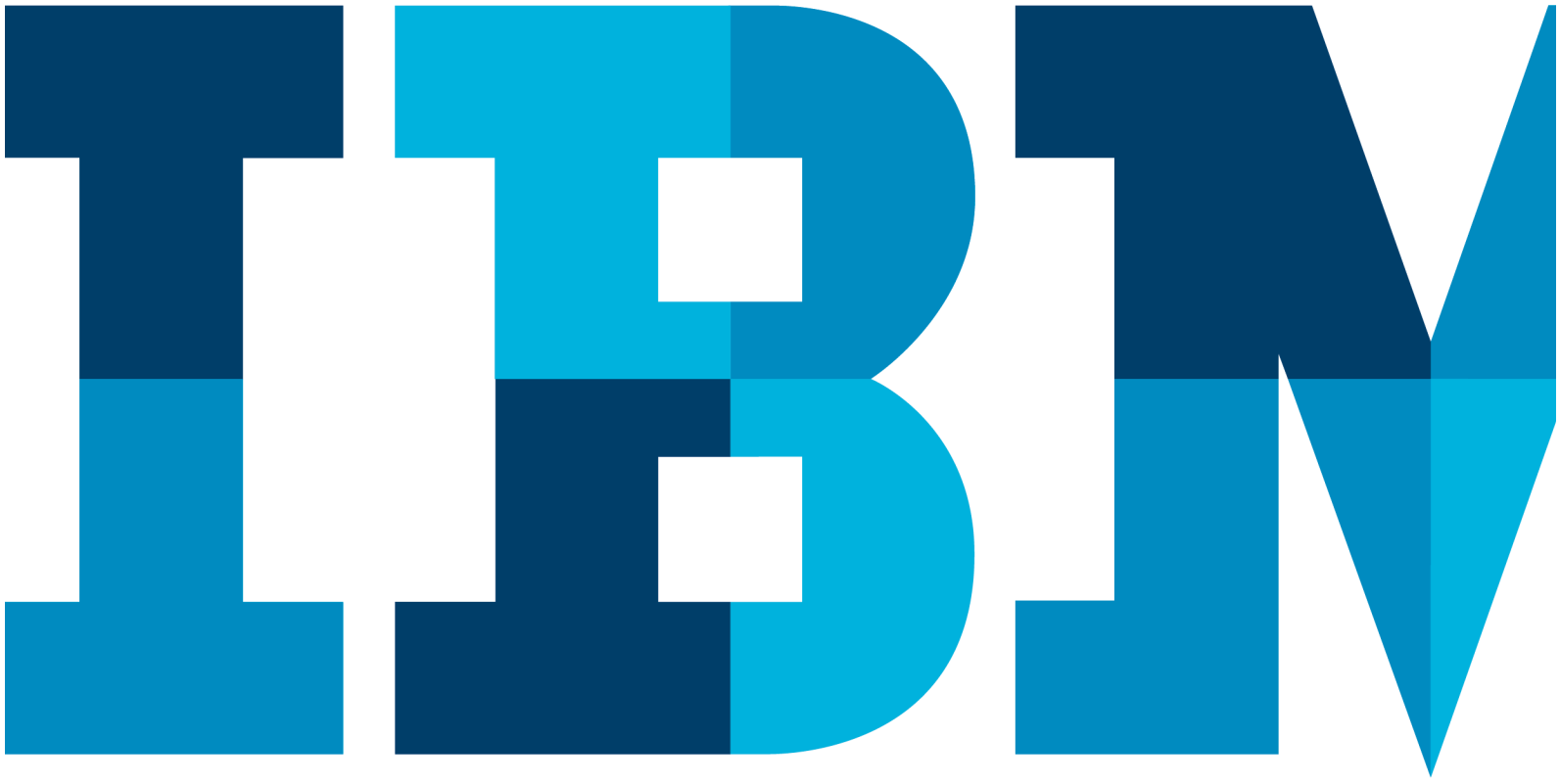
IBM Blockchain Hands-On
Blockchain Unchained

Lab Three – Bluemix – Exercises



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Overview

The aim of this lab is to introduce you to chaincode development by showing you how to create and deploy your first chaincode to a new Blockchain service in Bluemix.

We will use a sample piece of chaincode (Smart Contract) called **example02** as the foundation for our lab. This sample is provided as part of the Hyperledger Fabric code and accessible directly through Bluemix.

Once deployed, the chaincode can be invoked and queried.

Introduction

Prerequisites:

- A Firefox or Chrome browser with access to www.bluemix.net.
- A Bluemix account
- In order to edit and compile chaincode yourself, you also need:
  - GitHub account and tools (from https://github.com/)
  - GO Lang compiler installed (from https://golang.org/dl/)

It is recommended that students have previously completed the Blockchain Explained and Blockchain Explored labs.

For V0.61 of Hyperledger in Bluemix

Section 1. Creating the Blockchain Service on Bluemix

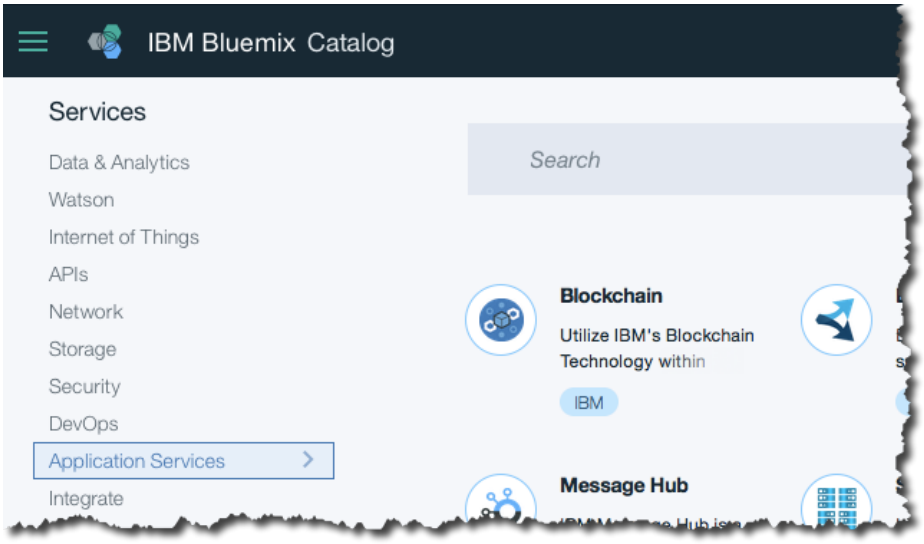
In this section we will use Bluemix to create a new Blockchain service. It does not require any services or applications to be pre-installed (such as the Car Leasing demo).

__1. Open a web browser (Firefox or Chrome are recommended) and go to www.bluemix.net.

__2. Click ‘Sign Up’ or ‘Log In’ to create a new Bluemix account or log into your existing account.

__3. Once you have successfully signed up and logged into Bluemix, select **Catalog** from the top bar.

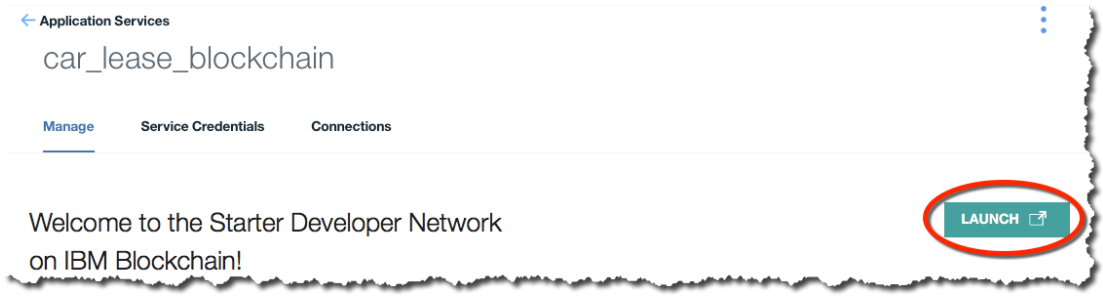
__4. In the ‘Services’ section of the sidebar, click ‘Application Services’ and select **Blockchain**.



__5. Review the service description and information about the service.

__6. Ensure that “Starter Developer plan” is selected and click **Create**, accepting the prompts to create an “org” and a “space” if you are prompted to do so. Wait for the service to be created.

__7. Click “Launch” to launch the blockchain administration console.

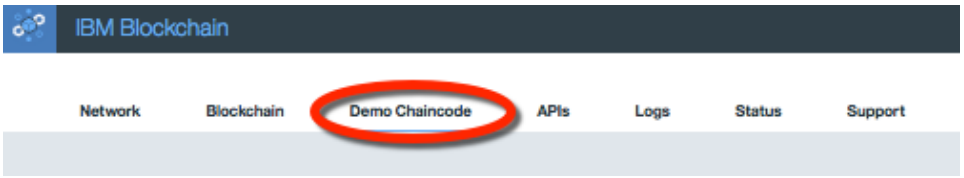


__8. Dismiss the welcome message.

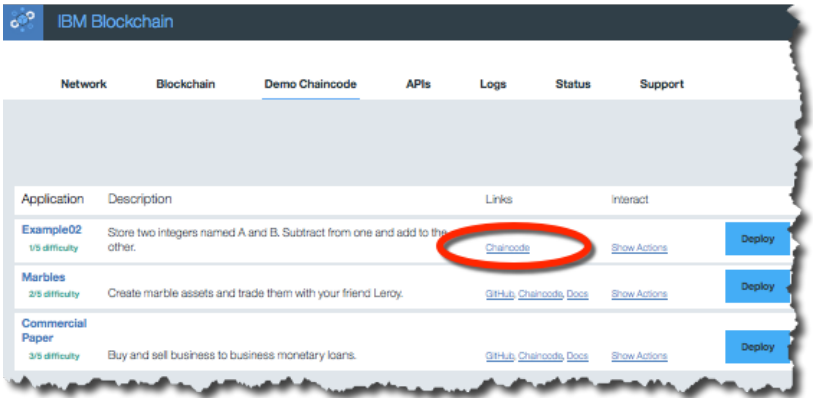
Section 2. Reviewing the Chaincode

In this section we will deploy some sample chaincode to the newly created blockchain.

__9. From within the blockchain administration console click the "**Demo Chaincode**" tab.



__10. Click the "**Chaincode**" link next to Example02.



This will take you to the Github site that contains the source code for the sample.

Upon initialization, this chaincode creates two key/value pairs in the world state. Each key is an identifier string (e.g. "A") whose value is an associated integer balance (e.g. 100). Transactions that invoke this chaincode will increment the balance of one identifier while decrementing the other.

For example:

Initializing the chaincode with ["a", "100", "b", "200"] will set up "a" to be "100" and "b" to be "200".
Invoking a transaction with ["a", "b", "10"] will decrement the value of "a" by 10 and increment "b" by the same amount.
Querying the value of "a" and "b" at this point will yield "a" to have the value "90" and "b" to have "210".

__11. Scroll down to the **Init** method.

```
func (t *SimpleChaincode) Init(stub *shim.ChaincodeStub, function string, args []string) ([]byte, error) {
        fmt.Printf("Init called, initializing chaincode")

        var A, B string    // Entities
        var Aval, Bval int // Asset holdings
        var err error

        if len(args) != 4 {
                return nil, errors.New("Incorrect number of arguments. Expecting 4")
        }

        // Initialize the chaincode
        A = args[0]
        Aval, err = strconv.Atoi(args[1])
        if err != nil {
                return nil, errors.New("Expecting integer value for asset holding")
        }
        B = args[2]
        Bval, err = strconv.Atoi(args[3])
        if err != nil {
                return nil, errors.New("Expecting integer value for asset holding")
        }
        fmt.Printf("Aval = %d, Bval = %d\n", Aval, Bval)

        // Write the state to the ledger
        err = stub.PutState(A, []byte(strconv.Itoa(Aval)))
        if err != nil {
                return nil, err
        }

        err = stub.PutState(B, []byte(strconv.Itoa(Bval)))
        if err != nil {
                return nil, err
```

1

2

Highlighted section (1) of the code is extracting the four initialization parameters (“A”, “100”, “B”, “200”). The code checks that they are of the required types.

Highlighted section (2) is storing those key/value pairs into the blockchain.

__12. Scroll down to the **invoke** method.

```go
// Transaction makes payment of X units from A to B
func (t *SimpleChaincode) invoke(stub *shim.ChaincodeStub, args []string) ([]byte, error) {
        fmt.Printf("Running invoke")

        var A, B string    // Entities
        var Aval, Bval int // Asset holdings
        var X int          // Transaction value
        var err error

        if len(args) != 3 {
                return nil, errors.New("Incorrect number of arguments. Expecting 3")
        }

        A = args[0]
        B = args[1]

        // Get the state from the ledger
        // TODO: will be nice to have a GetAllState call to ledger
        Avalbytes, err := stub.GetState(A)
        if err != nil {
                return nil, errors.New("Failed to get state")
        }
        if Avalbytes == nil {
                return nil, errors.New("Entity not found")
        }
        Aval, _ = strconv.Atoi(string(Avalbytes))

        Bvalbytes, err := stub.GetState(B)
        if err != nil {
                return nil, errors.New("Failed to get state")
        }
        if Bvalbytes == nil {
                return nil, errors.New("Entity not found")
        }
        Bval, _ = strconv.Atoi(string(Bvalbytes))

        // Perform the execution
        X, err = strconv.Atoi(args[2])
        Aval = Aval - X
        Bval = Bval + X
        fmt.Printf("Aval = %d, Bval = %d\n", Aval, Bval)

        // Write the state back to the ledger
        err = stub.PutState(A, []byte(strconv.Itoa(Aval)))
        if err != nil {
                return nil, err
        }

        err = stub.PutState(B, []byte(strconv.Itoa(Bval)))
        if err != nil {
                return nil, err
        }

        return nil, nil
}
```


Highlighted section (1) of the code retrieves the current values of the two keys from the world state.

Highlighted section (2) of the code increments and decrements the values of the keys accordingly.

Highlighted section (3) of the code writes the updated key/value pairs back to the world state.

__13. Scroll down to the **Query** method.

```
// Query callback representing the query of a chaincode
func (t *SimpleChaincode) Query(stub *shim.ChaincodeStub, function string, args []string) ([]byte, error) {
        fmt.Printf("Query called, determining function")

        if function != "query" {
                fmt.Printf("Function is query")
                return nil, errors.New("Invalid query function name. Expecting \"query\"")
        }
        var A string // Entities
        var err error

        if len(args) != 1 {
                return nil, errors.New("Incorrect number of arguments. Expecting name of the person to query")
        }

        A = args[0]

        // Get the state from the ledger
        Avalbytes, err := stub.GetState(A)
        if err != nil {
                jsonResp := "{\"Error\":\"Failed to get state for " + A + "\"}"
                return nil, errors.New(jsonResp)
        }

        if Avalbytes == nil {
                jsonResp := "{\"Error\":\"Nil amount for " + A + "\"}"
                return nil, errors.New(jsonResp)
        }

        jsonResp := "{\"Name\":\"" + A + "\",\"Amount\":\"" + string(Avalbytes) + "\"}"
        fmt.Printf("Query Response:%s\n", jsonResp)
```

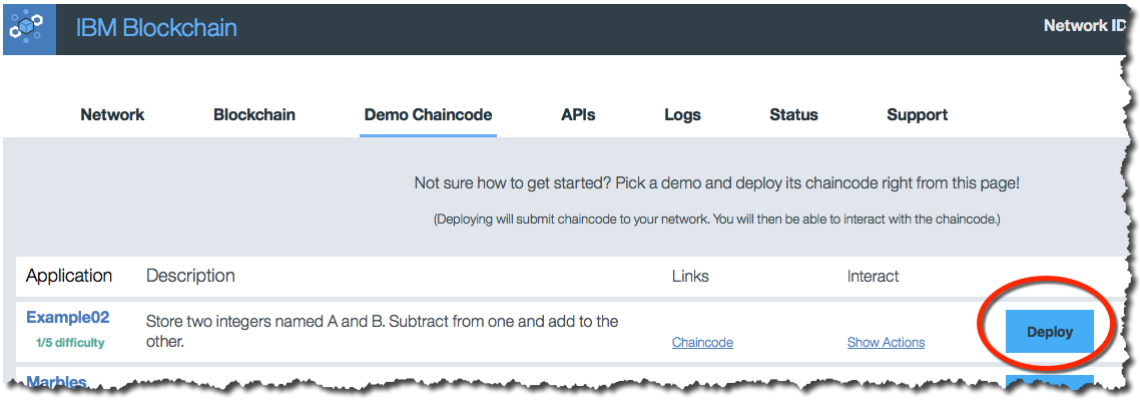
1

Highlighted section (1) retrieves the value of a key from the world state. This is converted into a JSON data structure and returned to the caller.

Section 3. Deploying, Invoking and Querying the Chaincode

We will now deploy the chaincode to our Blockchain service and make sure it works.

__14. Return to the blockchain administration console in Bluemix and click on the '**Deploy**' button next to the Example02 application.

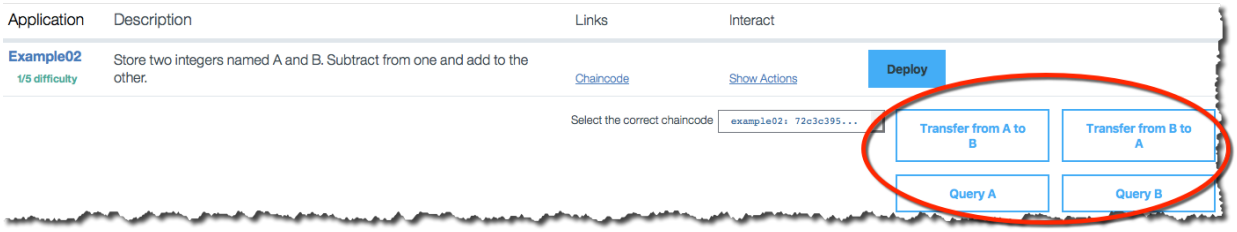


The panel at the bottom of the web page will show the process of deployment. Notice that a "user" is logged into the blockchain service before the chaincode can be deployed to the validating peers. The entire process should only take a few seconds to complete.

```
Registering enrollID dashboarduser_type1_0
  Success - registering enrollID

Deploying chaincode https://github.com/masterDev1985/hyperledger_chaincode/chaincode_example02
  Success - deployment (wait for the cc to start up)...
```

Once the deployment has completed, the web page will be updated to show the actions that can be performed against the chaincode.



__15. Click '**Query A**' to show the value of the "A" key. This is displayed in the log.

```
Querying function - query ["a"]
  Success - query 100
```

__16. Click '**Transfer from A to B**' to decrement the value of "A" by 5 and increment "B" by the same amount.

```
Invoking function - invoke
  Success - invocation 933b18be-d305-4e2e-a97b-2daf378376ca
```

__17. Click '**Query A**' to view the updated value of "A".

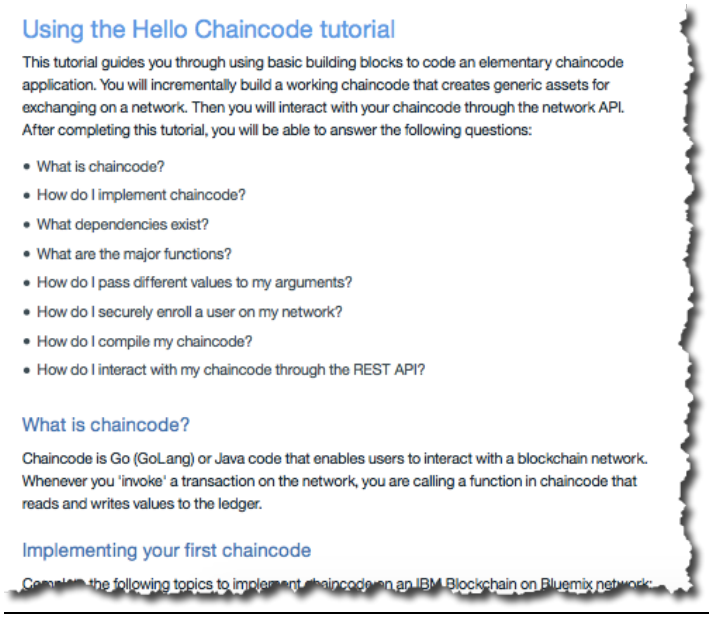
```
Querying function - query ["a"]
  Success - query 95
```

In the next section of the lab, we will edit, compile and redeploy the chaincode on your local machine. If you are not in a chaincode development role, it is recommended you end the lab now as this is an advanced section that has a number of software pre-requisites for you to install.

Section 4. Extending the Chaincode

In this advanced section of the lab, we will now go and modify the chaincode. This requires you to have the ability to do local development on your machine.

__1. Return to the Bluemix Blockchain service documentation “Samples and tutorials” page (https://console.ng.bluemix.net/docs/services/blockchain/ibmblockchain_tutorials.html). Scroll down to the “Using the Hello Chaincode tutorial” section.



Using the Hello Chaincode tutorial

This tutorial guides you through using basic building blocks to code an elementary chaincode application. You will incrementally build a working chaincode that creates generic assets for exchanging on a network. Then you will interact with your chaincode through the network API. After completing this tutorial, you will be able to answer the following questions:

- What is chaincode?
- How do I implement chaincode?
- What dependencies exist?
- What are the major functions?
- How do I pass different values to my arguments?
- How do I securely enroll a user on my network?
- How do I compile my chaincode?
- How do I interact with my chaincode through the REST API?

What is chaincode?

Chaincode is Go (GoLang) or Java code that enables users to interact with a blockchain network. Whenever you 'invoke' a transaction on the network, you are calling a function in chaincode that reads and writes values to the ledger.

Implementing your first chaincode

Complete the following topics to implement chaincode on an IBM Blockchain on Bluemix network:

__2. Follow the “Implementing your first chaincode” section of this documentation. In summary you will need to:

a. Install and configure Golang

b. Set up GitHub and fork the example “Hello Chaincode” repository.

c. Clone the “Hello Chaincode” fork to your local system. Make sure you clone the forked version rather than the original. If you accidently clone the original repository, then you can point to your fork using:

```
git remote set-url origin https://github.com/<yourGitID>/learn-chaincode
```

d. Edit the chaincode_start.go file to add in new capability for invoking and querying the chaincode.

e. Commit your local changes with:

```
git commit -a
```

f. Upload your changes back to your forked repository with "**`git push`**".

g. Using the Blockchain service API in Bluemix, deploy, invoke and query the new version of chaincode.

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