



Java Labs

1 Installation & Configuration SDK



Documentation & Examples

Open the documentation for Java SDK!

- <https://docs.couchbase.com/java-sdk/current/hello-world/start-using-sdk.html>
- <https://docs.couchbase.com/sdk-api/couchbase-java-client/>
- Check the Sample Application
<https://docs.couchbase.com/java-sdk/current/hello-world/sample-application.html>



Including the SDK

```
// Gradle
dependencies {
    ...
    implementation 'com.couchbase.client:java-client:3.2.5'
    ...
}
```

```
// Maven
<dependencies>
  <dependency>
    <groupId>com.couchbase.client</groupId>
    <artifactId>java-client</artifactId>
    <version>3.2.5</version>
  </dependency>
</dependencies>
```

TIP. Check last version available here:

<https://docs.couchbase.com/java-sdk/current/hello-world/start-using-sdk.html>



Lab 1: Preparing for the Lab

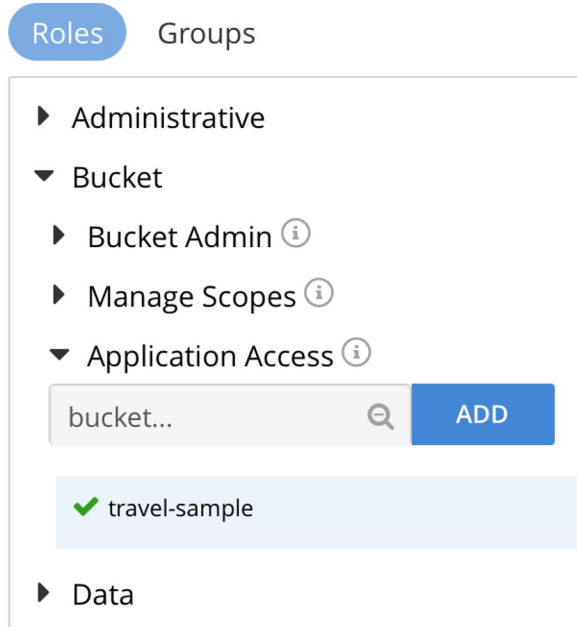
- Clone the source repository in your home folder.

`git clone https://github.com/couchbase-ps/cb-workshop-2d.git`

- Make sure Couchbase Server is running on your Machine and you have travel-sample bucket

- Create a user for the application access

- Go the Security Tab in Couchbase
- Create a new User.
- Username = "travel"
- Password = "couchbase"
- Role: Application Access on 'travel-sample'



Lab



Lab 1: Build & Run

Update dependency on the libcouchbase:

- Open **java/Lab/pom.xml**
- Change Couchbase Java client dependency to the latest

Build a simple executable jar:

```
cd cb-workshop-2d/java/Lab
mvn clean compile assembly:single
```

Run main class:

```
java -classpath target/CbDevWorkshop-0.0.1-SNAPSHOT-jar-with-dependencies.jar -
Dcbworkshop.clusteraddress=<Cluster IP> -Dcbworkshop.user=travel -
Dcbworkshop.password=couchbase -Dcbworkshop.bucket=travel-sample com.cbworkshop.MainLab
```

Or run using **docker**

```
docker-compose up -d && docker attach java-lab
```

Lab

2

Java SDK Connecting to Couchbase



Connection Basics

```
// Java
import com.couchbase.client.java.Cluster;
import com.couchbase.client.java.Collection;

ClusterEnvironment env = ClusterEnvironment.builder()
    .timeoutConfig(TimeoutConfig
        .connectTimeout(Duration.ofSeconds(15)))
    // more custom configuration
    .build();

Cluster cluster = Cluster.connect("<host1>, ..., <hostN>",
    clusterOptions("<username>",
        "<password>")
        .environment(env));

cluster.authenticate("<username>", "<password>");
Collection collection = cluster.bucket("<bucket-name>").defaultCollection();
```

- Reuse cluster and bucket objects, e.g. as singletons
- Make sure to provide more than one hostIP for high availability



Lab 2: Couchbase Connection

- Use source file: MainLab.java
- Implement method `initConnection()`
- Read config values from System properties:
 - `cbworkshop.clusteraddress`
 - `cbworkshop.user`
 - `cbworkshop.password`
 - `cbworkshop.bucket`
- Connect to the bucket with the given credentials
- Run application
- Check output:

```
mars 04, 2022 11:18:59 AM com.couchbase.client.core.cnc.LoggingEventConsumer$JdkLogger info
INFOS: [com.couchbase.core][CoreCreatedEvent]
{"clientVersion":null,"clientGitHash":null,"coreVersion":null,"coreGitHash":null, ...}
{"coreId":"0xa564412c00000001","seedNodes":[{"address":"localhost"}]}
```

```
mars 04, 2022 11:18:59 AM com.couchbase.client.core.cnc.LoggingEventConsumer$JdkLogger info
INFOS: [com.couchbase.node][NodeConnectedEvent] Node connected
{"coreId":"0xa564412c00000001","managerPort":"8091","remote":"localhost"}
```

```
mars 04, 2022 11:19:00 AM com.couchbase.client.core.cnc.LoggingEventConsumer$JdkLogger info
INFOS: [com.couchbase.core][BucketOpenedEvent][222ms] Opened bucket "travel-sample"
{"coreId":"0xa564412c00000001"}
```

Lab

3 **Java SDK** **Key-Value Operation**



Creating Documents

- Data can be flat or complex
- Document keys can be custom, automatically generated, or incrementing
- The `insert` operator will create new documents if the key does not already exist
- The `upsert` operator will create or replace

```
JsonObject data = JsonObject.create()
    .put("firstname", "Nic")
    .put("lastname", "Raboy");
JsonArray address = JsonArray.create()
    .add(JsonObject.create().put("city", "Mountain View").put("state", "CA"))
    .add(JsonObject.create().put("city", "San Francisco").put("state", "CA"));
data.put("address", address);
collection.insert(person-1, data);
```



Retrieving Documents by Key

- Data can be retrieved using a key-value lookup or with a N1QL query
- Lookups are significantly faster than indexed queries with N1QL

```
// Java  
collection.get("person-1").contentAsObject();
```



Lab 3: Create Object

- Implement method: `create(String[] words)`
- Compose a JSON document like this:
 - Use the command line parameters from `words`:
 - document key
 - from
 - to
 - Compose key with prefix `"msg: "` + provided key
 - Set timestamp to `System.currentTimeMillis()`
 - Set type to `"msg"`
- Use insert
 - Try several times. See results in console
 - Try same key (Error should appear!)
- Try upsert instead of insert

Key:

`msg:some_text`

```
{
  "timestamp": 1511184840248,
  "from": "luis",
  "to": "daniel",
  "type": "msg"
}
```

Lab



Lab 4: Read Object

- Implement method: `read(String[] words)`
- Use the command line parameter:
 - Document key
- Read the document
- Write the json string to `System.out`
- Test with values:
 - `airline_10226`
 - `route_10009`
 - `hotel_10904`

```
# read airline_10226
```

```
{"country":"United States","iata":"A1","callsign":"atifly","name":"Atifly","icao":"A1F","id":10226,"type":"airline"}
```

- **Extra Bonus:** implement code to output a friendly message when document is not found

Lab



Lab 5: Update Object

- Implement method: `update(String[] words)`
- Use the command line parameters:
 - Document key (prefix with "airline_" in code)
- Read the document
- Modify attribute "name": set the same value converted toUpperCase
- Use `replace` to modify

```
# read airline_10642
{"country":"United Kingdom","iata":null,"callsign":null,"name":"Jc royal.britannica","icao":"JRB","id":10642,"type":"airline"}
# update 10642
# read airline_10642
{"country":"United Kingdom","iata":null,"callsign":null,"name":"JC ROYAL.BRITANNICA","icao":"JRB","id":10642,"type":"airline"}
..
```

Lab



Lab 6: Delete Object

- Implement method: delete(String[] words)
- Use the command line parameter:
 - Document key (prefix with "msg::" in code)
- Delete document
- Tip: use create, then delete same key
- Try to read it to test if it is actually deleted

```
# create 1001 luis ana
# read msg::1001
{"from":"luis","to":"ana","type":"msg","timestamp":1511192232720}
# delete 1001
# read msg::1001
java.lang.NullPointerException
#       at com.cbworkshop.MainLab.read(MainLab.java:95)
#       at com.cbworkshop.MainLab.process(MainLab.java:60)
#       at com.cbworkshop.MainLab.main(MainLab.java:30)
```

Lab

4

Java SDK Subdocument API



The Goal: Working with Parts of a Document

- Get parts of a JSON Document
- Update individual JSON attributes in a document
- Batch subdocument operations together



Large Documents

```
key: nraboy
```

```
{
  "profile": {
    "firstname": "Nic",
    "lastname": "Raboy"
  },
  "data": [
    // 20MB of data
  ]
}
```



Get Part of a Document

```
// Java
LookupInResult result = collection
    .lookupIn("nraboy",
        List.of(
            LookupInSpec.get("profile")
        )
    );
```



Update Part of a Document

```
// Java
collection
    .mutateIn("nraboy", List.of(
        MutateInSpec.upsert("profile.firstname",
            "Nicolas")
    ));
```



Chain Subdocument Operations

```
collection
    .mutateIn("nraboy", List.of(
        MutateInSpec.replace("profile.firstname",
            "Nic"),
        MutateInSpec.insert("profile.gender", "Male"),
        MutateInSpec.remove("data")),
    mutateInOptions()
        .durability(PersistTo.ACTIVE,
            ReplicateTo.NONE));

LookupInResult result = collection.lookupIn("nraboy", List.of(
    LookupInSpec.get("sub.value"),
    LookupInSpec.exists("fruits")));

String subValue = result.contentAs(0, String.class);
boolean fruitsExist = result.contentAs(1, Boolean.class);
```



Lab 7: SubDocument API example

- Implement method: `subdoc(String[] words)`
- Use the command line parameter:
 - Document key (prefix with "msg::" from code)
- Using SubDocument API:
 - Change the actual value of the "from" attribute to "administrator"
 - Add a new attribute: "reviewed", with value `System.currentTimeMillis()`

```
# create 1005 juan santiago
# read msg::1005
{"from":"juan","to":"santiago","type":"msg","timestamp":1511196994278}
# subdoc 1005
# read msg::1005
{"reviewed":1511197006619,"from":"Administrator","to":"santiago","type":"msg","timestamp":1511196994278}
```

Lab

5

Java SDK Executing N1QL



Query String

Raw string query

```
QueryResult queryResult = cluster.query(  
    "SELECT * FROM `travel-sample` LIMIT 10");
```

Iterate over the query result

```
for (JsonObject row : queryResult.rowsAsObject()) {  
    System.out.println(row.toString());  
}
```



Query with Parameters

Sample code

```
String sourceairport = ...;
String destinationairport = ...;

String queryStr = "SELECT a.name FROM `travel-sample` r JOIN `travel-sample` a ON
KEYS r.airlineid WHERE r.type=\"route\" AND r.sourceairport=$src AND
r.destinationairport=$dst";

JsonObject params = JsonObject.create()
    .put("src", sourceairport)
    .put("dst", destinationairport);

QueryResult queryResult = cluster.query(queryStr, queryOptions()

    .parameters(params));
```



Query Consistency

- **not_bounded** (fastest)
 - Returns data that is currently indexed and accessible by the index or the view.
- **at_plus**
 - A query submitted with at_plus consistency level requires all mutations, up to the moment of the scan_vector (the logical timestamp passed in with at_plus), to be processed before the query execution can start.
- **request_plus**
 - Requires all mutations, up to the moment of the query request, to be processed before the query execution can start.

```
// Java
QueryResult result = cluster.query(queryStr, queryOptions()
    .scanConsistency(QueryScanConsistency.REQUEST_PLUS));
```



Lab 8: Simple Query

- Implement method: query (String[] words)
- Execute the query: "SELECT * FROM `travel-sample` LIMIT 10"
- Print the results to STDOUT
- Use both implementations, raw and query builder

```
# query
{"travel-sample":{"country":"United States","iata":"Q5","callsign":"MILE-AIR","name":"40-Mile Air","icao":"MLA","id":10,"type":"airline"}}
{"travel-sample":{"country":"United States","iata":"TQ","callsign":"TXW","name":"Texas Wings","icao":"TXW","id":10123,"type":"airline"}}
{"travel-sample":{"country":"United States","iata":"A1","callsign":"atifly","name":"Atifly","icao":"A1F","id":10226,"type":"airline"}}
{"travel-sample":{"country":"United Kingdom","iata":null,"callsign":null,"name":"JC ROYAL.BRITANNICA","icao":"JRB","id":10642,"type":"airline"}}
{"travel-sample":{"country":"United States","iata":"ZQ","callsign":"LOCAIR","name":"Locair","icao":"LOC","id":10748,"type":"airline"}}
{"travel-sample":{"country":"United States","iata":"K5","callsign":"SASQUATCH","name":"SeaPort Airlines","icao":"SQH","id":10765,"type":"airline"}}
{"travel-sample":{"country":"United States","iata":"K0","callsign":"ACE AIR","name":"Alaska Central Express","icao":"AER","id":109,"type":"airline"}}
{"travel-sample":{"country":"United Kingdom","iata":"5W","callsign":"FLYSTAR","name":"Astraeus","icao":"AEU","id":112,"type":"airline"}}
{"travel-sample":{"country":"France","iata":"UU","callsign":"REUNION","name":"Air Austral","icao":"REU","id":1191,"type":"airline"}}
{"travel-sample":{"country":"France","iata":"A5","callsign":"AIRLINAIR","name":"Airlinair","icao":"RLA","id":1203,"type":"airline"}}
```

Lab



Lab 9: Query with parameters

- Implement method: `queryAirports(String[] words)`
- Use the command line parameters:
 - `sourceairport`
 - `destinationairport`
- Write a query to find airlines (airline names) flying from `sourceairport` to `destinationairport`. Use JOIN
- Use a parametrized query
- **TIP:** Highest traffic airport codes: ATL, ORD, LHR, CDG, LAX, DFW, JFK

```
# queryairports JFK LHR
{"name": "British Airways"}
{"name": "Delta Air Lines"}
{"name": "American Airlines"}
{"name": "US Airways"}
{"name": "Virgin Atlantic Airways"}
{"name": "Air France"}
```

Lab

6 Java SDK Reactive programming



Why reactive programming?

- Synchronous programming is straightforward, e.g. simple loop to create multiple documents

```
for(JsonDocument doc : docs) {  
    bucket.insert(doc);  
}
```

- But difficult to achieve high throughput
 - E.g. if insert takes 1ms, maximum throughput is 1000 op/s
- Multithreading can increase throughput, but creates a lot of overhead
- Reactive programming provides an efficient way to achieve high throughput



Flux Pattern

- Flux = a stream of data
- Reactor operators to manipulate the stream

	<i>Single</i>	<i>Multiple</i>
<i>Sync (Pull)</i>	<i>T</i>	<i>Iterable<T></i>
<i>Reactive (Push)</i>	<i>Mono<T></i>	<i>Flux<T></i>



Batching with Reactor

- Implicit batching is performed by utilizing a few operators:
 - **Flux.just()** or **Flux.from()** to generate a Flux that contains the data you want to batch on.
- **flatMap()** to process the stream events with the Couchbase Java SDK and merge the results asynchronously.
- **last()** to wait until the last event of the stream is received
- **collectList()** to transform the events into a single list of results. Useful for reading data
- **block()** transforms the stream into a synchronous call returning the result



Batching with Reactor

- The following example creates a Flux of 5 keys to load in a batch,
- asynchronously fires off `get()` requests against the SDK,
- waits until the last result has arrived,
- and then converts the result into a list and blocks at the very end

```
Cluster cluster = Cluster.connect(...);
Collection collection = cluster.bucket("bucketName").defaultCollection();

Flux.just("key1", "key2", "key3", "key4")
    .flatMap(key -> collection.reactive().get(key))
    .map(GetResult::contentAsObject)
    .collectList()
    .block();
```



Batching with Reactor

- If you wrap the code in a helper method, you can provide very nice encapsulated batching semantics

```
public List<JsonObject> bulkGet(final Collection<String> ids) {  
    return Flux.just("key1", "key2", "key3", "key4")  
                .flatMap(key -> collection.reactive().get(key))  
                .map(GetResult::contentAsObject)  
                .collect(Collectors.toList())  
                .block();  
}
```

Batching with Reactor



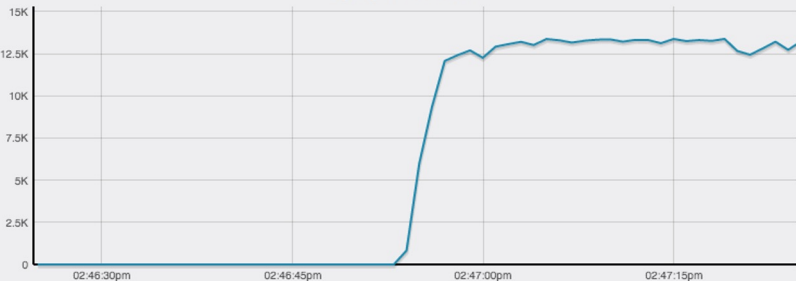
Here are two code samples, both synchronous, that showcase serialized and batched

```
while (true) {  
    List<JsonObject> loaded = new ArrayList<>();  
    int docsToLoad = 10;  
    IntStream.range(0, docsToLoad)  
        .forEach(i -> {  
            try {  
                loaded.add(  
  
                    collection.get("doc-" + i)  
  
                    .contentAsObject());  
            } catch (DocumentNotFoundException e) {}  
        });  
}
```

General Bucket Analytics

Last 1 minute

ops per second



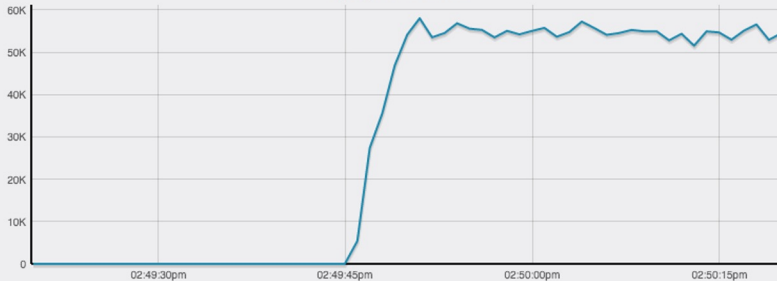
SERVER RESOURCES

```
while (true) {  
    int docsToLoad = 10;  
    Flux.range(0, docsToLoad)  
        .flatMap(i ->  
  
            collection.reactive()  
  
                .get("doc-" +  
  
                    i))  
  
                .onErrorResume(  
  
                    DocumentNotFoundException.class,  
  
                    e ->  
  
                        Mono.empty())  
  
                .toIterable();  
}
```

General Bucket Analytics

Last 1 minute

ops per second



SERVER RESOURCES



Batching with Reactor - Batching mutations

- The following code generates a number of fake documents and inserts them in one batch.
- Note that you can decide to either collect the results with **toIterable()** as shown before or just use **blockLast()** as shown here to wait until the last document is properly inserted.

```
// Generate a number of dummy JSON documents
int docsToCreate = 100;
Flux.range(0, docsToCreate)
    // Insert them in one batch, waiting until the last one is done.
    .flatMap(i -> collection.reactive()
        .insert("msg:." + i, JsonObject.create()
            .put("counter", i)
            .put("name", "Foo Bar")))
    .blockLast();
```



Bulk Read Reactive

```
List<String> priceKeys = ...;  
List<JsonObject> res = Flux.fromIterable(priceKeys)  
    .flatMap(k -> collection.reactive().get(k))  
    .map(GetResult::contentAsObject)  
    .collectList()  
    .block();
```



Bulk Write Reactive

Sync version:

```
Map<String, JsonObject> documents = ...;
documents.forEach((key, doc) ->
    collection.insert(key, doc));
```

Reactive version:

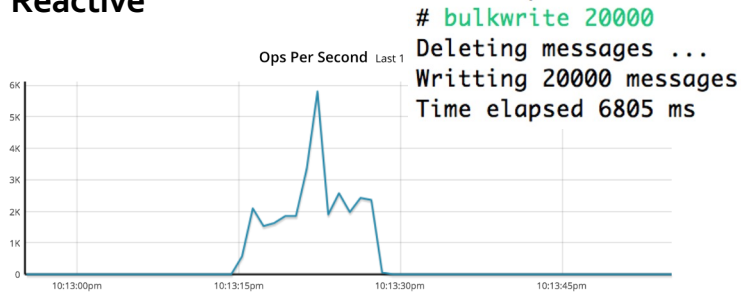
```
Map<String, JsonObject> documents = ...;
Flux.fromStream(documents.entrySet().stream())
    .flatMap(e -> collection.reactive()
        .insert(e.getKey(), e.getValue()))
    .blockLast();
```



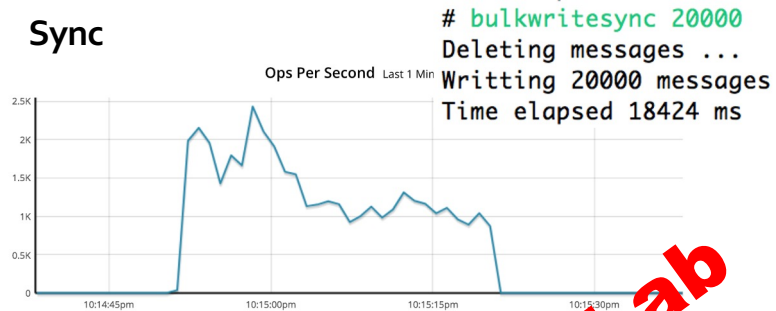
Lab 10: Bulk Write Performance

- Implement method: `bulkWrite (String[] words) : Reactive` version
- Implement method: `bulkWriteSync (String[] words) : Sync` version
- Read parameters from command line:
 - size: Number of messages to insert. Keys will be from `msg::1` to `msg::[size]`
- Delete all messages in the bucket: `DELETE FROM `travel-sample` WHERE type="msg"`
- Create a list of `JsonObject` of messages
- Insert the messages into the collection (in reactive / sync way)
- Print the time elapsed to STDOUT
- Compare results sync vs. reactive. Check both time and operations per second in the console

Reactive



Sync



Lab



Query Reactive mode

```
cluster.reactive()  
  .query("SELECT * FROM `travel-sample` LIMIT 5")  
  .flatMapMany(ReactiveQueryResult::rowsAsObject)  
  .subscribe(row -> System.out.println(row.toString()),  
             e -> System.err.println("N1QL Error/Warning: " + e));
```

- Unlike the synchronous method, does not block the calling thread
- The query results are processed asynchronously as they arrive by the `subscribe` handlers



Lab 11: Simple Query – Reactive version

- Implement method: `queryReactive (String[] words)`
- Execute the query: `"SELECT * FROM `travel-sample` LIMIT 5"`
- Print the results to STDOUT
- Use reactive implementation

```
# queryasync
# {"travel-sample":{"country":"United States","iata":"Q5","callsign":"MILE-AIR","name":"40-Mile Air","icao":"MLA","id":10,"type":"airline"}}
{"travel-sample":{"country":"United States","iata":"TQ","callsign":"TXW","name":"Texas Wings","icao":"TXW","id":10123,"type":"airline"}}
{"travel-sample":{"country":"United States","iata":"A1","callsign":"atifly","name":"Atifly","icao":"A1F","id":10226,"type":"airline"}}
{"travel-sample":{"country":"United Kingdom","iata":null,"callsign":null,"name":"JC ROYAL.BRITANNICA","icao":"JRB","id":10642,"type":"airline"}}
{"travel-sample":{"country":"United States","iata":"ZQ","callsign":"LOCAIR","name":"Locair","icao":"LOC","id":10748,"type":"airline"}}
```

Lab



Thank you



Couchbase