Introduction to
NoSQL Application Development (Java)

Couchbase 5.x+ (5.0.1) / Couchbase Java SDK 2.x+ (2.5.4)

Lab Workbook

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Lab 1 - Install Couchbase server, project files, and REST API tool for testing

Objectives

A	Install and configure Couchbase Server 5.x as a single node
B	Survey the Couchbase administration console
C	Import Java projects into Eclipse
D	Install REST API tool

This lab assumes you do not have Couchbase Server EE 5.x installed. If you do, you should be able to complete all labs in this course using your existing installation. But, you may encounter small differences relative to the lab descriptions, depending on your version and configuration.

This course assumes you are already familiar with, and will use the open source Eclipse IDE, configured for Java development, with the M2Eclipse Maven tools installed. The project files can also be imported into other IDE's, such as IntelliJ IDEA.

A. Install and configure Couchbase Server 5.x as a single node cluster

1. Download *Couchbase Server Enterprise Edition 5.x* for your operating system.

   http://www.couchbase.com/downloads

2. Review the Release Notes, and install as described in the documentation for your OS:

   http://docs.couchbase.com

   Note, on Windows, you must run the installer using elevated Administrator permissions. To explore container-based installation, see:

   http://www.couchbase.com/containers.

3. Unless the Couchbase Setup tool launches automatically, open a web browser, and browse to this URL to launch the Setup tool.

   http://localhost:8091

4. Select *Setup New Cluster*

5. In the Setup tool, review all settings and accept all defaults, except for changing these:

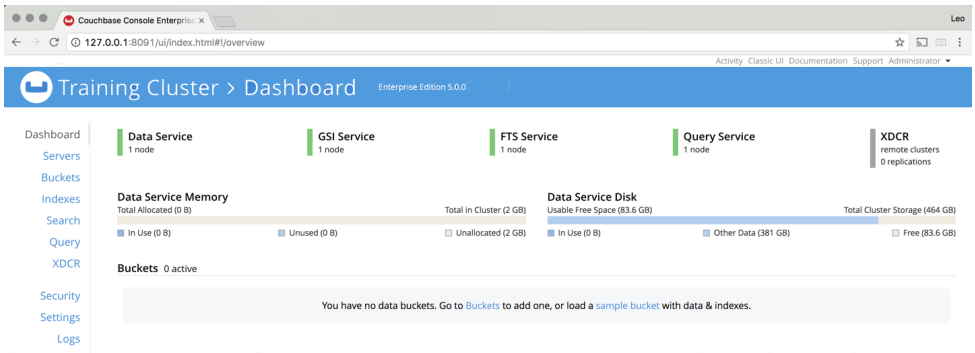
    - ❏ Cluster Name: *Training Cluster*
    - ❏ Admin Username: *Administrator*
    - ❏ Password: *password*
    - ❏ Accept the Terms and Conditions (*check*)
    - ❏ Configure Disk, Memory, Services (*click*)
        - ❏ Data Service (*check*): *2048mb*
        - ❏ GSI Service (*check*): *1024mb*
        - ❏ FTS Service (*check*): *512mb*
        - ❏ Query Service (*check*)
        - ❏ Memory-Optimized Global Secondary Indexes (*check*)

    Note, if requested by your local firewall, accept incoming network connections for *beam.smp*, *memcached*, *epmd*, *indexer*, *moxi*, *projector*, *cbq-engine*, and *cbft*. A full list of port requirements is available here:

    https://developer.couchbase.com/documentation/server/current/install/install-ports.html

    Note, the settings above run a single low-impact Couchbase instance on a local system for learning purposes only. Please see the Couchbase documentation for guidance on memory sizing for production machines, or for any performance-related purpose.

6. After completing Setup, you should see this screen. If not, browse http://localhost:8091.



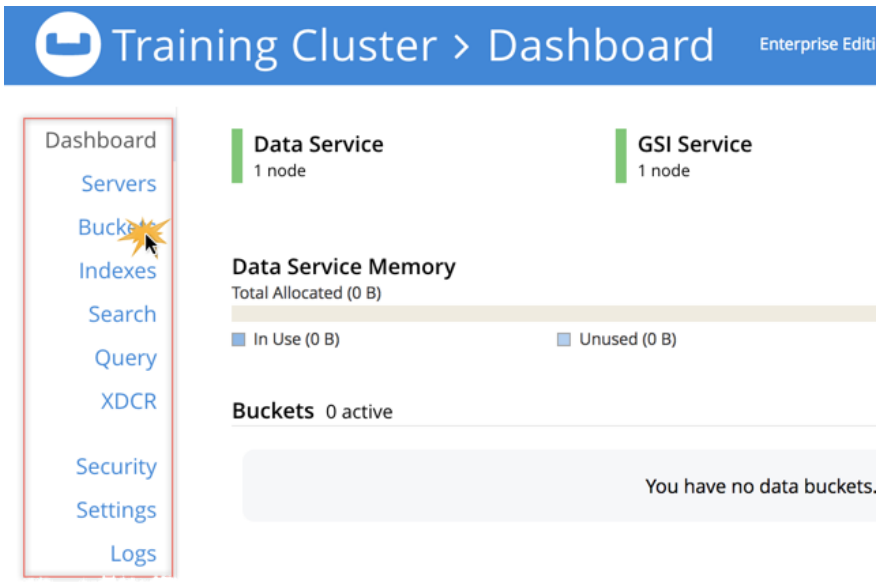
B. Survey the Couchbase administration console

7. In the Couchbase UI, navigate to and briefly review each top-level screen.

   For a solid introduction to the essential concepts of Couchbase technology, please take this free online training at http://training.couchbase.com/online.

   CB030 - Essentials of Couchbase NoSQL Technology

   Documentation is available at http://docs.couchbase.com

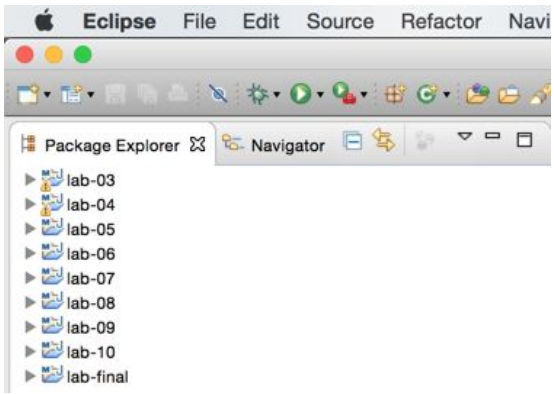


C. Import Java projects into Eclipse

5. From the learning management system, download the Java projects archive for these labs to your desktop:

   CB130J-Eclipse-Projects-[version].zip

6. Launch Eclipse and import all projects in this archive. After import, you should see this:



D. Install REST API tool

Note, feel free to use any REST API testing tool you prefer for this course.

7. Download and install a REST API tool. We recommend Postman.

https://www.getpostman.com/

End of Lab

Lab 2 - Manually create a Couchbase data bucket and JSON document, then preview the final application

Objectives

A	Manually create a data bucket
B	Manually add a document to a data bucket
C	Configure user security to enable customer360 bucket access
D	Run the final application and preview its behavior
E	Load additional documents into customer360 using cbimport

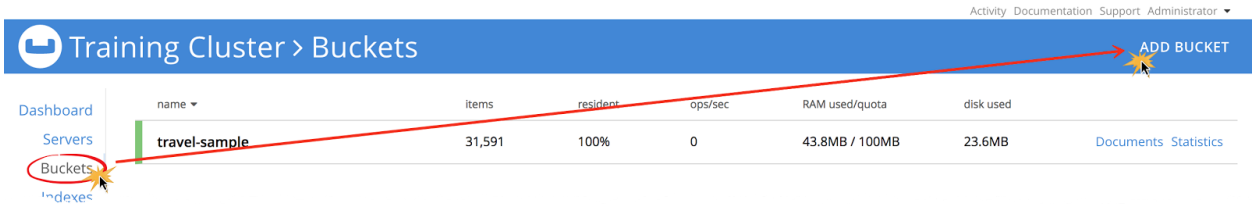
In this lab, you configure the data bucket and document you will use in later labs. Then, you run the final application to observe some of the behaviors you'll be creating ahead.

Note, throughout this course, code and JSON which you must type in appears in blue.

A. Manually create a data bucket

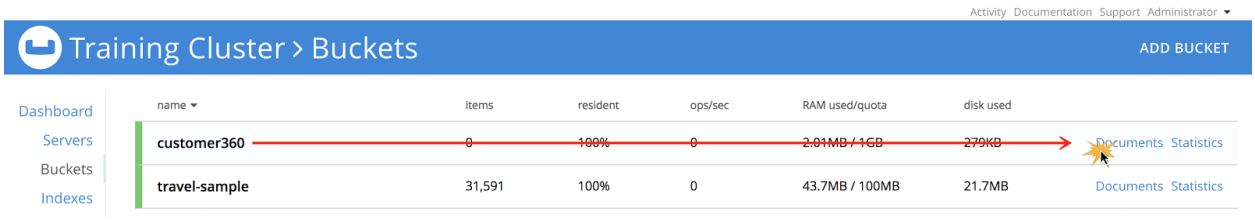
1. In the Couchbase administration console, navigate to the *Buckets* view, and select *Add Bucket*. Review all settings, and accept all defaults, except for these:

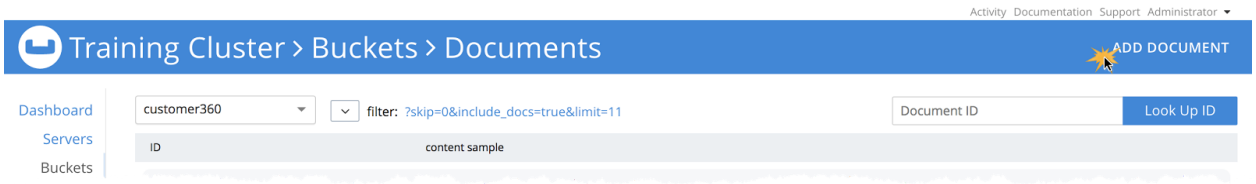
    - ❏ Name: *customer360*
    - ❏ Memory Quota: *1024mb*
    - ❏ Advanced Settings (*click*)
        - ❏ Replicas: *Disable (uncheck)*
        - ❏ Flush: *Enable (check)*



B. Manually add a document to a data bucket

2. When the bucket is available, open its *Documents* view, and select *Add Document*.





3. Assign the following value as the Document ID, then create the document:

```
customer::bblue22
```

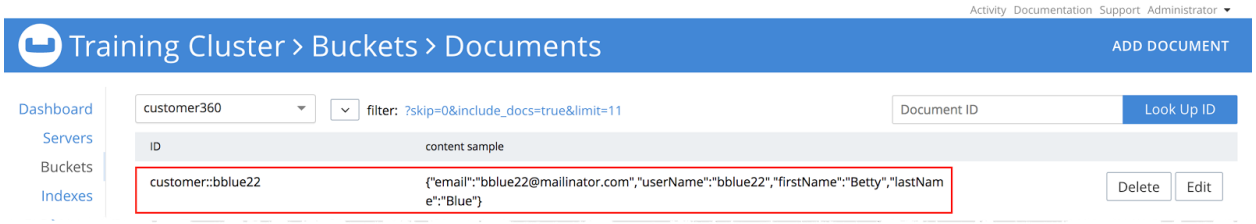
Note, the general format *type::id* is a common convention for Document IDs in Couchbase, and is used in this course. But, it is only a convention. It is not required.

4. Edit and save the document with the following JSON value:

```
{
  "email": "bblue22@mailinator.com",
  "userName": "bblue22",
  "firstName": "Betty",
  "lastName": "Blue"
}
```

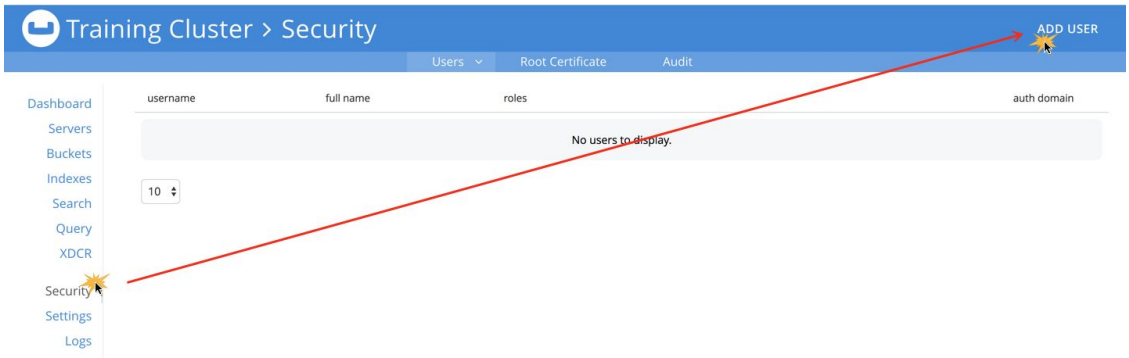
Note, you can copy and paste all JSON snippets from this document.

5. In the navigation trail, click *Documents* to view the summary list of documents in the *customer360* bucket

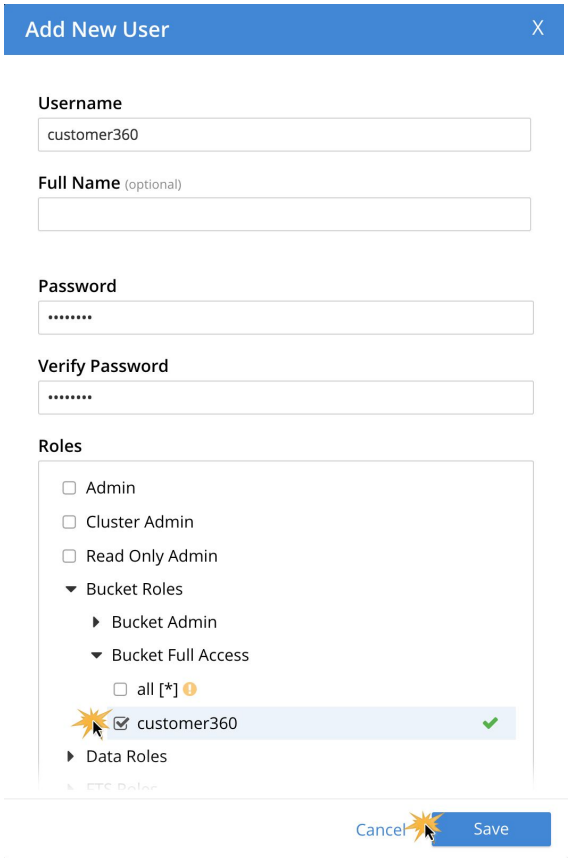


C. Configure user security to enable customer360 bucket access

6. In the Couchbase UI, select the Security tab to open User configuration.



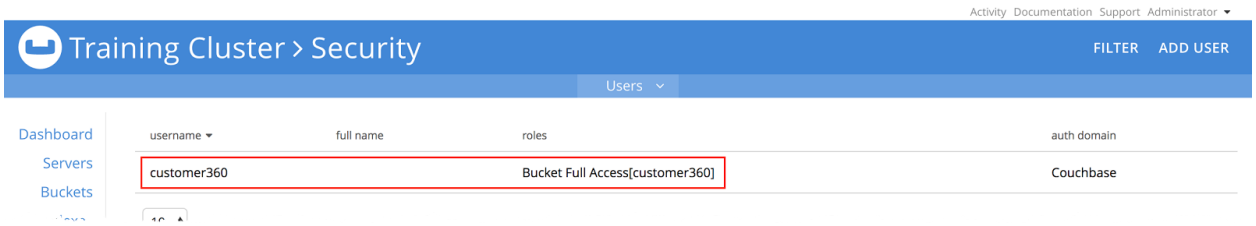
7. Add a new user matching the name of the bucket created above (e.g., "*customer360*"), set a password (e.g., "*password*"), and configure this user for Full Access to this bucket.



Note, unless otherwise specified in the client, a SDK request is mapped to a User account matching the name of the Bucket against which the request is made. This account will provide access to otherwise anonymous clients when making requests to the *customer360* bucket, provided they send the password specified for this account.

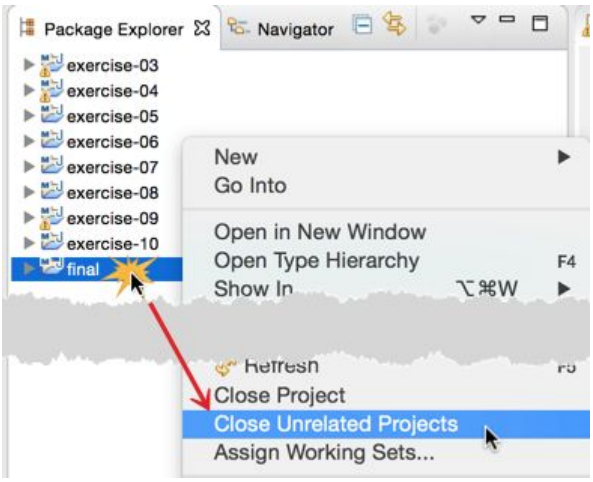
Much more granularly identified and secured approaches are also available. See the Roles Based Access Control (RBAC) sections of the Couchbase Server 5.0 Enterprise Edition documentation for further detail.

8. Save your changes to this new account. You should see the following.



D. Run the final application and preview its behavior

6. In Eclipse, close projects which are unrelated to the *final* project.



7. In the *final* project, open *Application.java*, right-click and run it as a Java application.

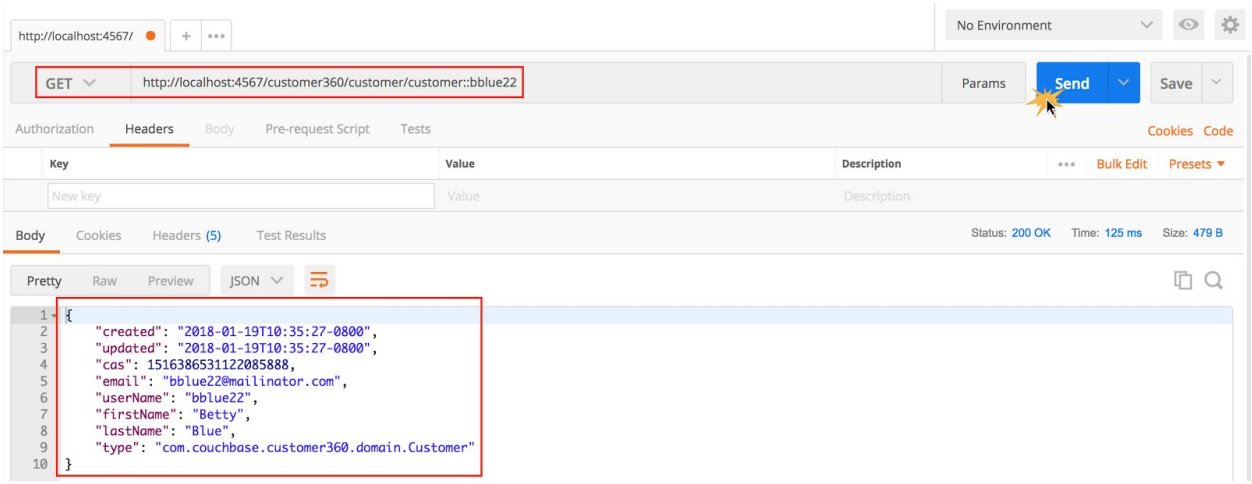
8. If your Couchbase server is running, and you have created the *customer360* bucket, you should see the following:

Note, port 4567 is in use by SparkJava, which is being used to create this REST API. The Couchbase SDK itself connects to Couchbase Server via ports 11210, 11211, etc.

9. Leave the application running, launch your REST API tool, and make this GET request to retrieve the document:

    - ❏ HTTP Verb (Method): GET
    - ❏ URL for SparkJava: *http://localhost:4567*
    - ❏ Base application URL: */customer360*
    - ❏ Controller extension: */customer*
    - ❏ Document ID: *customer::bblue22*

```
http://localhost:4567/customer360/customer/customer::bblue22
```



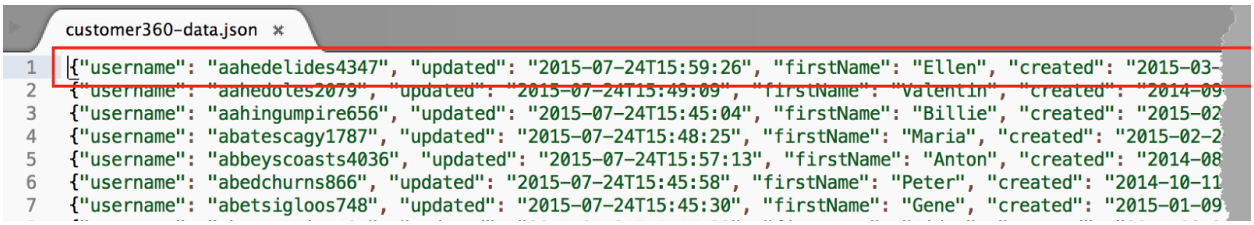
Note, port 4567 is in use by SparkJava, which is being used to create this REST API. The Couchbase SDK itself connects to Couchbase Server via ports 11210, 11211, etc.

10. Stop the running Java application.

E. Load additional documents into customer360 using cbimport

You want to bulk load data into the bucket you have created.

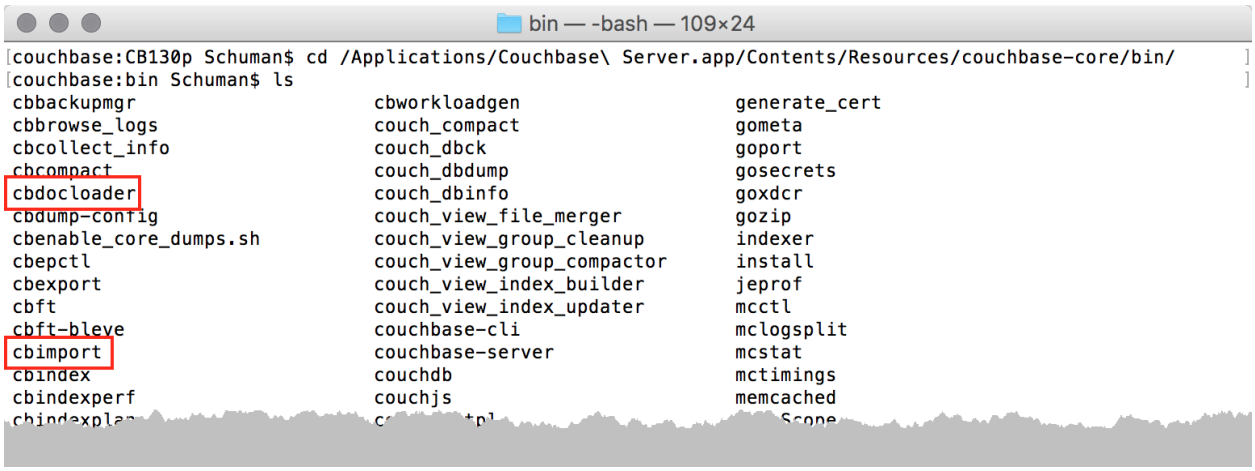
11. Download the *customer360-data.json* file to your desktop or similar location. Using Eclipse or your preferred tool, examine the structure of this document.



Note, each line of *customer360-data.json* contains a JSON document (object). Each document includes a unique *id* value.

12. Open a Terminal (Command) window, navigate to the Couchbase *bin* folder, and briefly review the contents of this folder. Notice the *cbimport* and *cbdocloader* tools.

macOS	/Applications/Couchbase Server.app/Contents/Resources/couchbase-core/bin/
Windows	C:\Program Files\Couchbase\Server\bin\
Linux	/opt/couchbase/bin/



13. Add this *bin* folder to the PATH environment variable for your operating system, so that its commands may be invoked from any command line location. See your operating system documentation for details on this process.
14. In the Terminal, navigate to the */CB130j* folder, which contains *customer360-data.json.*

15. Use *cbimport* to load the JSON documents in the *customer360-data.json* file to the *customer360* bucket. Assign the *id* element of each record as its document key, prefixed by "*customer*" as a document *type* identifier, using "*::*" as a separator.

    - ❏ Cluster (-c): *couchbase://127.0.0.1*
    - ❏ Username (-u): *Administrator*
    - ❏ Password (-p): *password*
    - ❏ Bucket (-b): *customer360*
    - ❏ Format (-f): *lines*
    - ❏ Dataset (-d): *file://customer360-data.json*
    - ❏ Threads (-t): *2*
    - ❏ Key Pattern to Generate (-g): *customer::%id%*

    cbimport json -c couchbase://127.0.0.1 -u Administrator -p password -b customer360 -f lines -d file://customer360-data.json -t 2 -g customer::%id%

    For full detail on using *cbimport*, see the documentation:

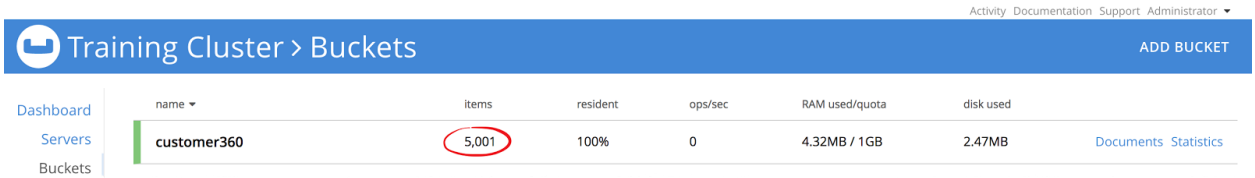
    https://developer.couchbase.com/documentation/server/current/tools/cbimport.html

    Note, any document value can be used for key generation. It is a common JSON design pattern to prefix document keys with a type identifier (e.g., "*customer*::aaa123"). When using *cbimport*, prefixing can be specified using key generation, as shown above. When using *cbdocloader* and the prescribed Couchbase sample file format, the file names of your documents, which may include prefixing as shown in the provided archive, become key names for the loaded documents.

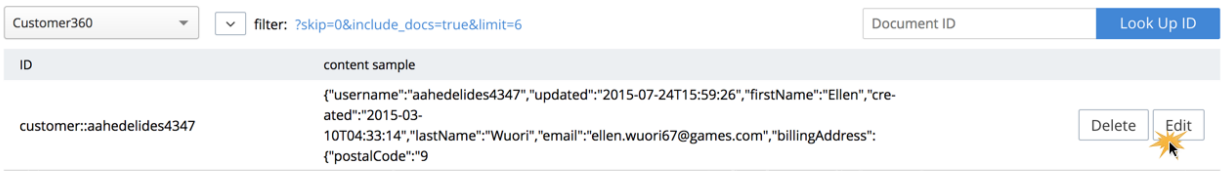
    For an introduction to data modeling in JSON, please take this free Online Training course at http://training.couchbase.com/online.

    CB105 - Introduction to Data Modeling in JSON

16. In the Couchbase UI, verify you've loaded 5,000 additional documents - beyond the one you created - to the *customer360* bucket, and open the *Documents* screen.



17. In the *Documents* screen, Edit the first document to review its structure.



18. Notice the related metadata object.

End of Lab

Lab 3 - Create a Couchbase cluster reference and open a specified bucket

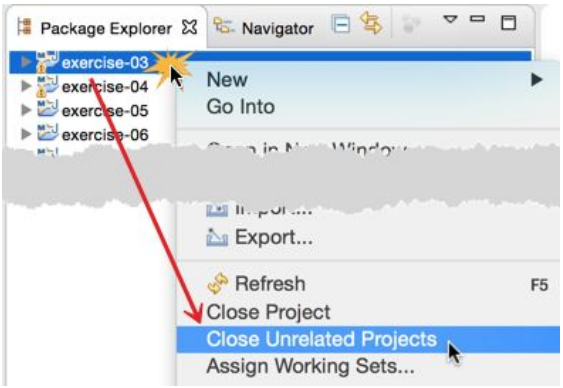
Objectives

A	Survey the *customer360* application
B	Understand how the cluster reference is created
C	Use the cluster to open a bucket reference, with and without password

In this lab, you survey and orient yourself to the application code. Then, you create a cluster reference, and write code to open the bucket you created in the prior lab, within this cluster, using a password if the bucket has been secured.

A. Survey the customer360 application

1. In Eclipse, open the the *lab-03* project, and close unrelated projects.



2. Review the code in this project, in light of the descriptions provided in the related video materials. Focus on reviewing these three classes. You may also wish to review the code in the *final* project.

    - *Application.java*
    - *BaseController.java*
    - *CouchbaseRepository.java*

    Note, this application implements a straightforward way to build a REST-based interface for Couchbase, relying on the Sinatra-inspired Spark web framework, and synchronous API calls. Asynchronous, reactive approaches using RxJava, are also available.

    To maximize clarity for learners who may be new to Java, exception handling is minimized in the labs, though is fully implemented in the lab-final project.

B. Understand how the cluster reference is created

3. In *Application.java*, review the *main* method. Specifically, notice:

   - ❏ How the node addresses are loaded from a properties file
   - ❏ How a cluster reference is created for those node(s)
   - ❏ How the repository is created for this cluster for the *customer360* bucket
   - ❏ How the cluster is used to create the controllers

```
public static void main(String[] args) {
	final Properties props = System.getProperties();
	try {
		props.load(getSystemResourceAsStream(PROPERTIES_FILENAME));
	} catch (IOException e) {
		System.err.println("Unable to open " + PROPERTIES_FILENAME);
	}
	String[] nodes =
		props.getProperty(NODES_KEY, NODES_DEFAULT_VALUE).split(",");
	String username = props.getProperty(USER_NAME_KEY);
	String password = props.getProperty(USER_PASS_KEY);
	Cluster cluster = CouchbaseCluster.create(nodes);
	Repository repo = new CouchbaseRepository(cluster, username, password);
	new CustomerController(BASE_URL, repo);
}
```

C. Use the cluster to open a bucket reference, with and without password

4. In *CouchbaseRepository.java*, notice the *bucket* property.

```
public class CouchbaseRepository implements Repository {
	private final JsonConverter converter = new JacksonConverter();
	private final JsonTranscoder transcoder = new JsonTranscoder();
	private Bucket bucket;
```

5. In the first constructor, delete the *TODO* and thrown *UnsupportedOperationException*.
6. Use the *cluster* reference to open the passed bucket name.

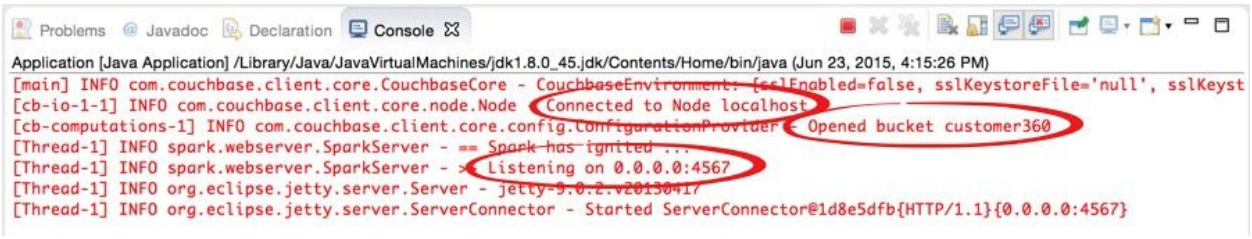
```
public CouchbaseRepository(Cluster cluster, String bucketName) {
	bucket = cluster.openBucket(bucketName);
}
```

7. In the second constructor, which supports a password, again open *bucketName*, but this time also using the *bucketPassword*.

```
public CouchbaseRepository(Cluster cluster, String bucketName,
	String bucketPassword) {
	bucket = cluster.openBucket(bucketName, bucketPassword);
}
```

Manually test the application

8. Run the *lab-03* project. You should see this console output, indicating you have successfully opened the bucket you've created.



10. Stop the running application.

End of Lab

Lab 4 - Get, serialize, deserialize, and return JSON from Couchbase

Objectives

A	Retrieve a document by its key
B	Deserialize a Java type to a JSON string
C	(Optional) Review REST method mapping in the Spark framework

In this lab you get a document by its key. More importantly, though, you begin learning how to handle the various states through which JSON data may pass in an application:

- ➢ *String*
- ➢ Application-specific Java domain type (e.g., *Customer*, *Product*, etc.)
- ➢ *JsonObject*
- ➢ *JsonDocument*

A. Retrieve a document by its key

1. In Eclipse, open the *lab-04* project, and close unrelated projects.
2. In *CouchbaseRepository.java*, locate the *findById* method, review its signature, and delete the TODO and placeholder exception.
3. Declare a local *JsonDocument* variable named *doc*.
4. Use the *get* method of the *bucket* reference to retrieve the passed Document ID, and assign the returned value to *doc*.

```
public <T extends Entity> T findById(String id, Class<? extends T> type) {
	JsonDocument doc = bucket.get(id);
}
```

B. Deserialize a Java type to a JSON string

5. In *CouchbaseRepository.java*, above the constructors, locate the *converter* and *transcoder* class variable declarations, and consider them in light of the descriptions provided in the related video materials. Specifically, notice:

   - ❏ *converter* could be any JSON converter which maps JSON strings to Java types
   - ❏ *converter* maps JSON strings to Java domain objects of a specified type
   - ❏ *transcoder* converts JSON strings to the Couchbase *JsonObject* type

```
public class CouchbaseRepository implements Repository {
	private final JsonConverter converter = new JacksonConverter();
	private final JsonTranscoder transcoder = new JsonTranscoder();
	private Bucket bucket;
```

6. Locate the *fromJsonDocument* method, and review it in light of the descriptions provided in the related video materials. Specifically, notice:

   - ❏ This application uses generics to flexibly handle multiple Java domain types, all of which derive from a base type called *Entity*
   - ❏ The Bucket API gets a *JsonDocument* object, holding its *JsonObject* as *content*
   - ❏ Calling *toString* on a *JsonObject* returns the underlying string of JSON
   - ❏ *JacksonConverter* converts a JSON string to a specified Java type

```
protected <T extends Entity> T fromJsonDocument(JsonDocument doc,
  Class<T> type) {
       if (doc == null) {
             throw new IllegalArgumentException("document is null");
       }
       JsonObject content = doc.content();
       if (content == null) {
             throw new IllegalStateException("document has no content");
       }
       if (type == null) {
             throw new IllegalArgumentException("type is null");
       }
       T result = converter.fromJson(content.toString(), type);
       return result;
}
```

7. In the *findById* method, if the retrieved document is not *null*, add code to convert it to the specified Java *type* using the *fromJsonDocument* method, and *return* it.

```
public <T extends Entity> T findById(String id, Class<? extends T> type) {
       JsonDocument doc = bucket.get(id);
       return doc == null ? null : fromJsonDocument(doc, type);
}
```

C. (Optional) Review REST method mapping in the Spark framework

8. (Optional) In *BaseController.java*, review how GET requests are mapped to retrieve the ID on the URL, and pass it to the *findById* method.

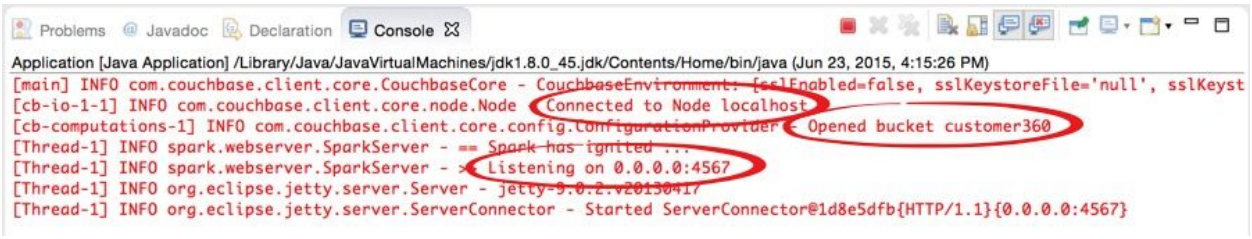
```
if(!methodList.contains(HttpMethod.get)) {
  Spark.get(baseURL + "/:id", new Route() {
    @Override
    public Object handle(Request request, Response response) {
      T entity = repo.findById(request.params(":id"), type);
      if(entity == null) {
        return error(response, HttpStatus.NOT_FOUND_404);
      } else {
        contentLocation(response, baseURL + "/" + entity.getId());
        return ok(response, entity);
      }
    }
  });
}
```

9. (Optional) In *BaseController.java*, review how the *ok(Response, T)* method uses the *converter* to deserialize the Java domain type back to a JSON string.

```
protected <T> String ok(Response response, T entity) {
       response.type("application/json");
       response.status(HttpStatus.OK_200);
       return converter.toJson(entity);
}
```

Manually test the application

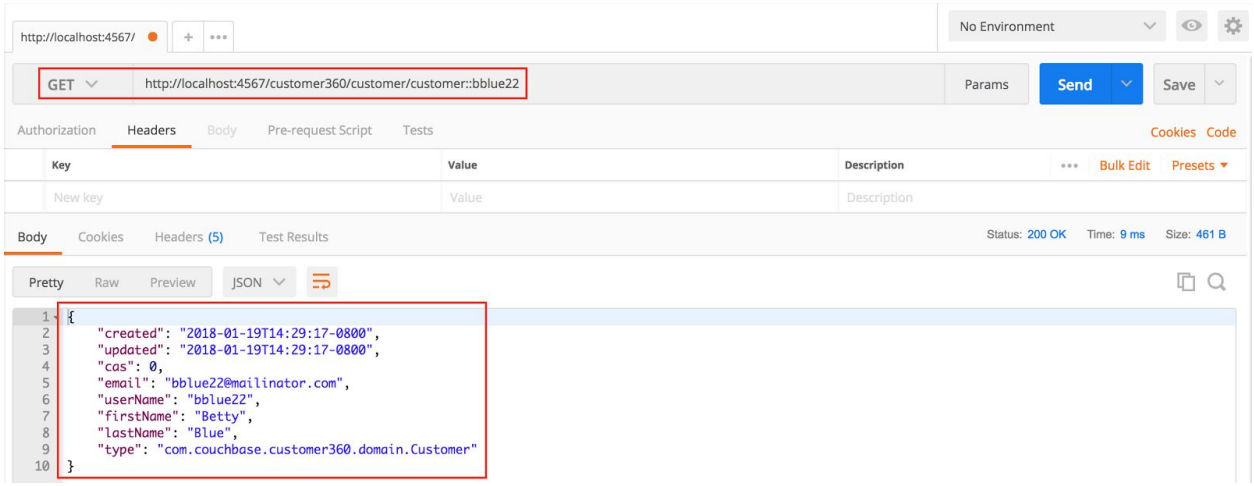
10. Run the *lab-04* project. You should see this console output:



9. Leave the application running, launch your REST API tool, and make this GET request to retrieve the document:

    - ❏ HTTP Verb (Method): GET
    - ❏ URL for SparkJava: *http://localhost:4567*
    - ❏ Base application URL: */customer360*
    - ❏ Controller extension: */customer*
    - ❏ Document ID: *customer::bblue22*

    `http://localhost:4567/customer360/customer/customer::bblue22`



10. Stop the running application.

End of Lab

Lab 5 - Serialize, transcode, and insert a JSON document to Couchbase

Objectives

A	Serialize JSON to a Java domain type
B	Transcode a Java domain type to a JsonDocument
C	Insert a new JSON document
D	Transcode a JsonDocument to a Java domain type

In this lab, you handle string input passed via the REST API, by serializing and transcoding as needed so that it is both available within the application as a Java domain type, as well as converted to a *JsonDocument* and inserted into Couchbase.

A. Serialize JSON to a Java domain type

1. In Eclipse, open the *lab-05* project, and close unrelated projects.
2. In *BaseController.java*, review how POST requests are handled. Specifically, notice:

    - ❏ The request body is converted from JSON to a Java domain object of its type
    - ❏ The Java domain object and its type pass to *CouchbaseRepository.create()*
    - ❏ The *create* result is passed to the *ok* method to serialize and return the response

```
if(!methodList.contains(HttpMethod.post)) {
	Spark.post(baseURL, new Route() {
		@Override
		public Object handle(Request request, Response response) {
			T entity = converter.fromJson(request.body(), type);
			contentLocation(response, baseURL + "/" + entity.getId());
			T result = repo.create(entity, type);
			return ok(response, result);
		}
	});
}
```

B. Transcode a Java domain type to a JsonDocument

3. In *CouchbaseRepository.java*, locate the *create* method, review its signature, and delete the *TODO* and placeholder exception. Notice the method receives a Java domain object, named *entity*, along with a reference to its *type*.

```
public <T extends Entity> T create(T entity, Class<? extends T> type) {

}
```

4. In the *create* method, pass the Java domain object passed in as *entity* to the *toJsonDocument* method for conversion, and assign the result to a *JsonDocument* variable named *docIn*.

```
public <T extends Entity> T create(T entity, Class<? extends T> type) {
	JsonDocument docIn = toJsonDocument(entity);
}
```

5. (Optional) Locate the *toJsonDocument* method, and review it in light of the descriptions provided in the related video materials. Specifically, notice:

   - ❏ This method converts a Java object, with some ID value, to a *JsonDocument*
   - ❏ The *converter* deserializes a Java object into a JSON string
   - ❏ The *transcoder* serializes a JSON string into a *JsonObject*
   - ❏ *JsonDocument.create()* builds a *JsonDocument* from an ID value and *JsonObject*

```
protected <T extends Entity> JsonDocument toJsonDocument(T source) {
	if (source == null) {
		throw new IllegalArgumentException("entity is null");
	}
	String id = source.getId();
	if (id == null) {
		throw new IllegalStateException("entity ID is null");
	}
	try {
		JsonObject content =
			transcoder.stringToJsonObject(converter.toJson(source));
		JsonDocument doc = JsonDocument.create(id, content);
		return doc;
	} catch (Exception e) {
		throw new RepositoryException(e);
	}
}
```

C. Insert a new JSON document

6. In the *create* method, use the *insert* method of the *bucket* to pass the new document to Couchbase for insertion. Assign the result of this method - which will include the inserted document's time stamp and CAS value - to a *JsonDocument* named *docOut*.

```
public <T extends Entity> T create(T entity, Class<? extends T> type) {
	JsonDocument docIn = toJsonDocument(entity);
	JsonDocument docOut = bucket.insert(docIn);

}
```

D. Transcode a JsonDocument to a Java domain type

7. Convert the resulting *JsonDocument* back into a Java domain object of its correct type, using the *fromJsonDocument* method, and *return* the result.

```
public <T extends Entity> T create(T entity, Class<? extends T> type) {
       JsonDocument docIn = toJsonDocument(entity);
       JsonDocument docOut = bucket.insert(docIn);
       return fromJsonDocument(docOut, type);
}
```

Manually test the application

8. Run the *lab-05* project. You should see this console output:

9. Leave the application running, launch your REST API tool, and make this GET request to retrieve the document:

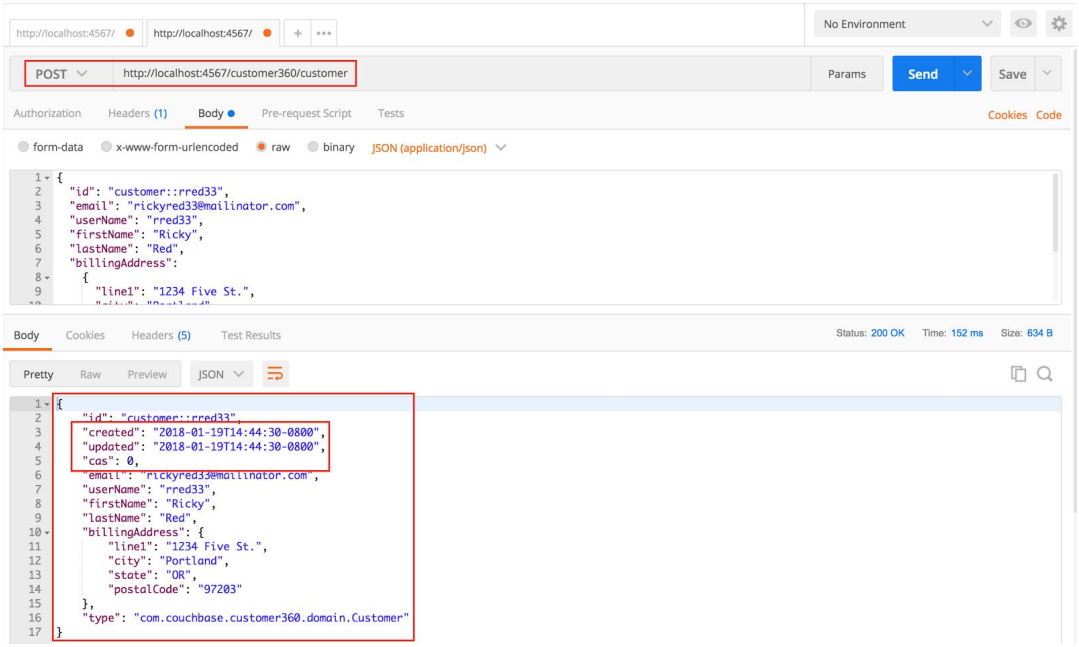
   - ❏ HTTP Verb (Method): POST
   - ❏ URL for SparkJava: *http://localhost:4567*
   - ❏ Base application URL: */customer360*
   - ❏ Controller extension: */customer*
   - ❏ Document ID: *none for a POST (must be in body)*

```
http://localhost:4567/customer360/customer
```

Body Content (note, you can copy and paste this code from this document):

```
{
  "id": "customer::rred33",
  "email": "rickyred33@mailinator.com",
  "userName": "rred33",
  "firstName": "Ricky",
  "lastName": "Red",
  "billingAddress":
    {
      "line1": "1234 Five St.",
      "city": "Portland",
      "state": "OR",
      "postalCode": "97203"
    }
}
```

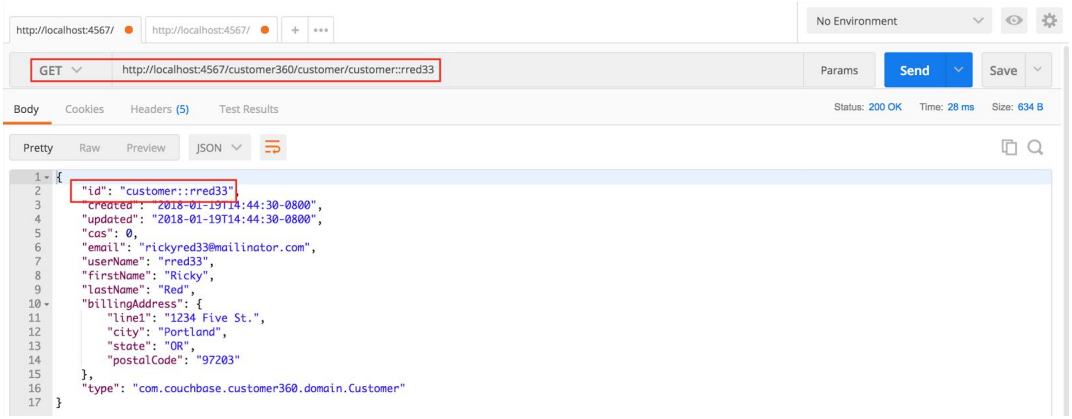
9. You should see the inserted document, with timestamp and CAS (not yet implemented at this point in the application, and so defaults to 0), in the Response Body Content.



10. Verify the document insertion by making a GET request for the new document. You should receive the same response as you saw returned from the insertion above.

    - ❏ HTTP Verb (Method): GET
    - ❏ URL for SparkJava: *http://localhost:4567*
    - ❏ Base application URL: */customer360*
    - ❏ Controller extension: */customer*
    - ❏ Document ID: *customer::rred33*

`http://localhost:4567/customer360/customer/`**`customer::rred33`**



11. Stop the running application.

End of lab

Lab 6 - Index and query using N1QL

Objectives

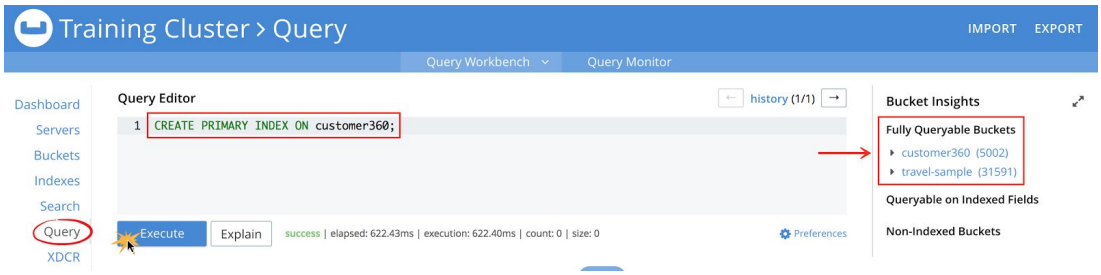
A	Create a primary index and execute queries via cbq
B	Retrieve nested documents by either value or Document ID (key)
C	Implement a parametrized N1QL query through the Java SDK
D	(Challenge) Find documents by indexed email fields

In this lab, you use *cbq* to index the *customer360* data bucket for ad hoc queries, and then execute N1QL queries against this data bucket. You then refactor the *findById()* method implemented in the prior lab, using N1QL and the Couchbase *query()* API.

A. Create a primary index and execute ad hoc N1QL queries

1. Open the Couchbase UI, and navigate to the *Query* screen.
2. To enable ad hoc queries for the *customer360* data bucket, execute the following N1QL statement. Once complete, *customer360* should appear as a Fully Queryable Bucket.

```
CREATE PRIMARY INDEX ON customer360;
```



B. Retrieve nested documents by either value or Document ID (key)

4. Select all keys and values for 10 documents from the *customer360* data bucket.

```
SELECT * FROM customer360 LIMIT 10;
```

5. Select both the document previously created, along with its metadata, by its document id, using a USE KEYS clause.

```
SELECT META() AS Metadata, * FROM customer360 USE KEYS ("customer::rred33");
```

6. Modify the query to select the same document, without its metadata, filtering by the *id* value embedded as a field within the document itself, using a WHERE clause.

```
SELECT * FROM customer360 WHERE id = "customer::rred33";
```

Note, document *id* values (aka, document keys) are always accessible via metadata, as shown. For learning purposes, the *customer360* documents also embed the *id* as a field within the document itself. For an introduction to data modeling in JSON, please take this free Online Training course at http://training.couchbase.com/online.

CB105 - Introduction to Data Modeling in JSON

C. Implement a parameterized N1QL query through the Couchbase SDK

7. In Eclipse, open the *lab-06* project, and close unrelated projects.
8. In *CouchbaseRepository.java*, locate the *findById* method, declare a *JsonDocument* variable named *doc*, and comment out the *get* method implemented in the prior lab.
9. Import the *CouchbaseException* class.

```
public <T extends Entity> T findById(String id, Class<? extends T> type) {
  JsonDocument doc;
  try {
    // doc = bucket.get(id);

  } catch (CouchbaseException e) {
    throw new RepositoryException(e);
  }
  return doc == null ? null : fromJsonDocument(doc, type);
}
```

10. In the *try* block, declare a String *statement* with the second N1QL query used above, but replacing the key value with *$1* as a placeholder for a positional parameter.
11. Create an *empty JsonArray* named *values*, and *add* the *id* parameter being passed to this method to the array.
12. *Build* a *N1qlParams* object named *params*, and set its *consistency* property to *ScanConsistency.REQUEST_PLUS*, to ensure strong consistency for this query.
13. Create a *ParameterizedN1qlQuery* named *query*, using *statement*, *values*, and *params*.
14. Update your *import* statements as needed:

```
...
import com.couchbase.client.java.query.N1qlParams;
import com.couchbase.client.java.query.ParameterizedN1qlQuery;
import com.couchbase.client.java.query.consistency.ScanConsistency;
...

public <T extends Entity> T findById(String id, Class<? extends T> type) {
  JsonDocument doc;
  try {
    // doc = bucket.get(id);
    String statement = "SELECT customer360.* FROM customer360 USE KEYS $1";
    JsonArray values = JsonArray.empty().add(id);
    N1qlParams params =
      N1qlParams.build().consistency(ScanConsistency.REQUEST_PLUS);
    ParameterizedN1qlQuery query =
      ParameterizedN1qlQuery.parameterized(statement, values, params);


  } catch (CouchbaseException e) {
    throw new RepositoryException(e);
  }
  return doc == null ? null : fromJsonDocument(doc, type);
}
```

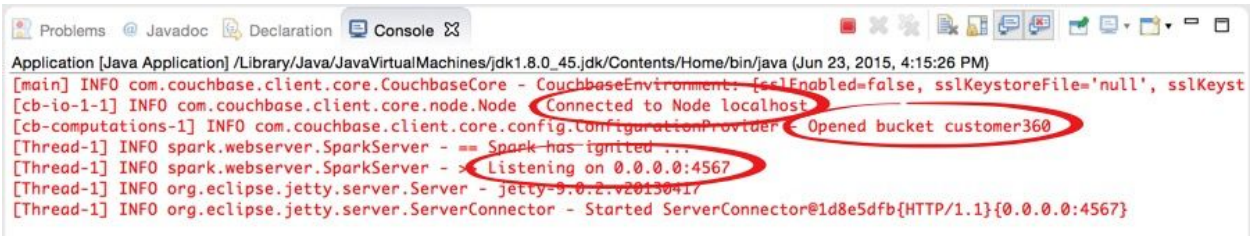
15. Pass the *query* to the *query* method of the *bucket*, and assign the value returned to a *N1qlQueryResult* named *result*.
16. Assign *allRows* of of the *result* to a *List* of *N1qlQueryRow* values, named *list*.
17. If there are 0 *rows* in the *list*, set *doc* to *null*.
18. Else, *get* the first element in *list*, and assign it to a *N1qlQueryRow* named *firstRow*.
19. Assign the *value* of *firstRow* to a *JsonObject* named *firstRowObject*.
20. Use *firstRowObject* and the *id* passed to this method, to *create* a *JsonDocument*, assigning the result to *doc*.
21. Update your import statements as needed.

```
...
import java.util.List;
import com.couchbase.client.java.query.N1qlQueryResult;
import com.couchbase.client.java.query.N1qlQueryRow;
...
public <T extends Entity> T findById(String id, Class<? extends T> type) {
  JsonDocument doc;
  try {
    // doc = bucket.get(id);
    String statement = "SELECT customer360.* FROM customer360 USE KEYS $1";
    JsonArray values = JsonArray.empty().add(id);
    N1qlParams params =
      N1qlParams.build().consistency(ScanConsistency.REQUEST_PLUS);
    ParameterizedN1qlQuery query =
      ParameterizedN1qlQuery.parameterized(statement, values, params);
    N1qlQueryResult result = bucket.query(query);
    List<N1qlQueryRow> list = result.allRows();
    if (list.size() == 0) {
       doc = null;
    } else {
       N1qlQueryRow firstRow = list.get(0);
       JsonObject firstRowObject = firstRow.value();
       doc = JsonDocument.create(id, firstRowObject);
    }

  } catch (CouchbaseException e) {
    throw new RepositoryException(e);
  }
  return doc == null ? null : fromJsonDocument(doc, type);
}
```

Note, from this point, having created a *JsonDocument* from the value returned for this Document ID, the *customer360* application should behave just as when using *get()*.

Note, this lab demonstrates fundamental aspects of the N1QL API, in context of this sample application. N1QL would primarily be used for selecting document sets, or querying by value, not getting single documents by ID, as shown.

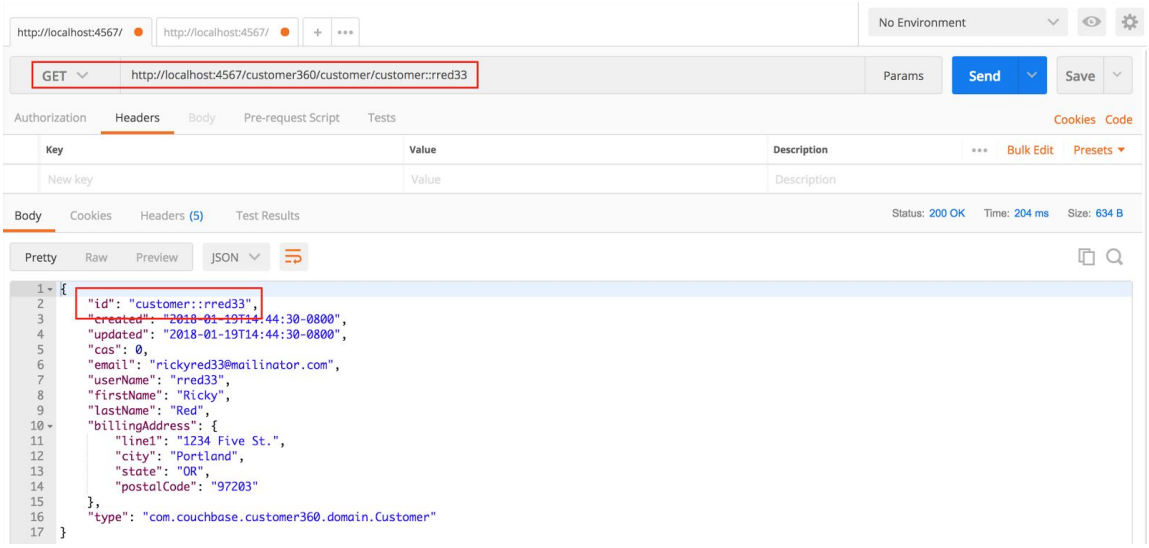
17. Run the *lab-06* project. You should see this console output:



18. Leave the application running, launch your REST API tool, and make this GET request to retrieve the document:

    - ❏ HTTP Verb (Method): GET
    - ❏ URL for SparkJava: http://localhost:4567
    - ❏ Base application URL: /customer360
    - ❏ Controller extension: /customer
    - ❏ Document ID: customer::rred33

`http://localhost:4567/customer360/customer/customer::rred33`



19. (Challenge) Rewrite the *findById* method to directly retrieve documents by their document key, by implementing a USE KEYS clause in the N1QL statement, instead of filtering for this value by the arbitrarily embedded *id* field.

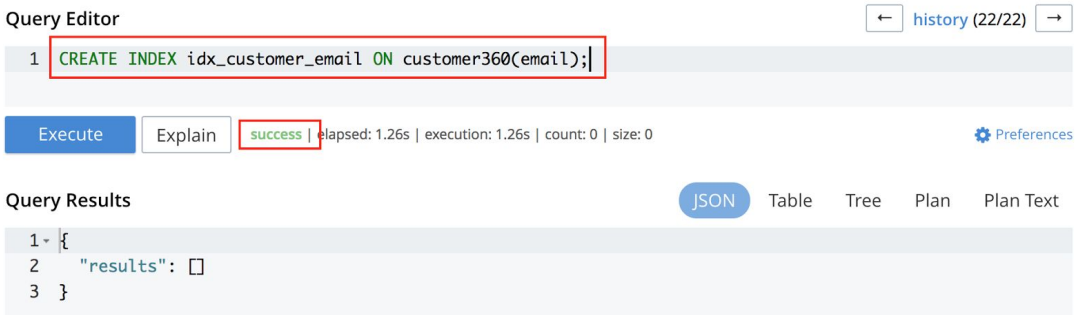
D. (Challenge) Find documents by indexed email fields

20. In the Couchbase UI Query screen, run the following query, and note the execution time.

```
SELECT * FROM customer360 WHERE email = "rickyred33@mailinator.com";
```

21. Create an index named *idx_customer_email* of *email* fields in *customer360* documents.

```
CREATE INDEX idx_customer_email ON customer360(email);
```



22. Click the back *history* button, and re-execute the prior select query. Notice the change in query execution time, now that a corresponding index is available.

23. (Challenge) In the *customer360* application, implement a *findByEmail* method.

    Note, the Couchbase Java SDK supports extensive features related to N1QL, including a DSL for query construction, along with support for asynchronous, reactive access patterns. As a SQL analogue, virtually every operation one could do with SQL, one can do with N1QL, including select, insert, update, and delete documents. For more information on N1QL and the Java SDK, explore the Couchbase documentation.

    For an thorough introduction to the N1QL Query Language, please take this free Online Training course at http://training.couchbase.com/online.

    CB110 - Introduction to N1QL Query Language

24. Stop the running application.

End of Lab

Lab 7 - Replace (“update”) a document

Objectives

A	Replace (“update”) an existing document
B	Consider Couchbase write behavior

In this lab, you use the bucket’s *replace* method to add a document which happens to have the same ID as an existing document. This effectively “updates” the prior version of the document.

In this scenario, the SDK returns an error on attempts to replace a document which does not already exist. Consider how this relates to the way Couchbase accepts incoming writes, particularly in comparison to the subsequent lab.

A. Replace (“update”) an existing document

1. In Eclipse, open the *lab-07* project, and close unrelated projects.
2. In *CouchbaseRepository.java*, locate the *update* method, review its signature, and delete the *TODO* and placeholder exception. Notice the method receives a Java domain object, named *entity*, along with a reference to its *type*.

```
public <T extends Entity> T update(T entity, Class<? extends T> type) {

}
```

3. Use the *toJsonDocument* method to convert the entity passed to this method into a *JsonDocument*, named *docIn*.

```
public <T extends Entity> T update(T entity, Class<? extends T> type) {
	JsonDocument docIn = toJsonDocument(entity);

}
```

4. (Optional) Review the *toJsonDocument* method, to follow how JSON formatted data is flowing through this application.
5. Pass *docIn* to the *update* method of the *bucket*, and assign the result to a *JsonDocument* named *docOut*.

```
public <T extends Entity> T update(T entity, Class<? extends T> type) {
	JsonDocument docIn = toJsonDocument(entity);
	JsonDocument docOut = bucket.replace(docIn);

}
```

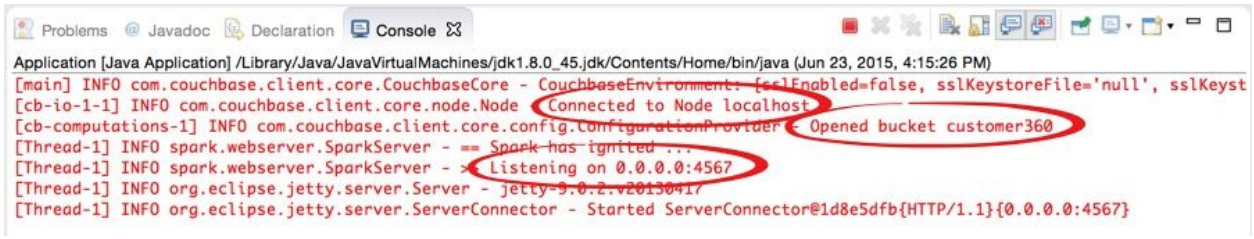
6. Use the *fromJsonDocument* method to convert *docOut* back to a Java domain object of the specified *type*, and *return* the result from the method.

```
public <T extends Entity> T update(T entity, Class<? extends T> type) {
        JsonDocument docIn = toJsonDocument(entity);
        JsonDocument docOut = bucket.replace(docIn);
        return fromJsonDocument(docOut, type);
}
```

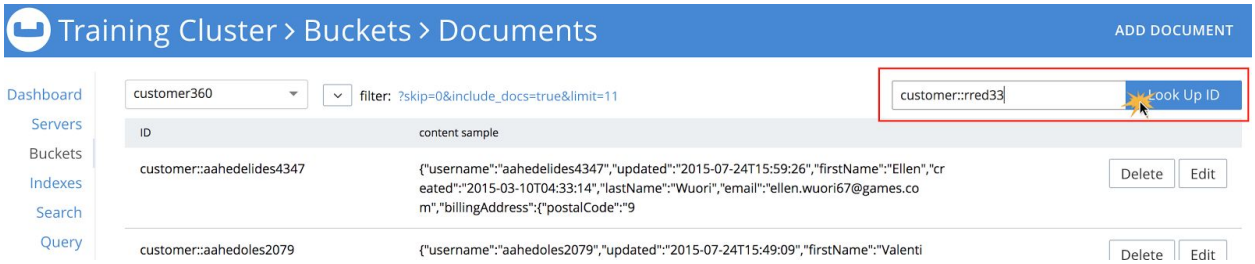
7. (Optional) Review the *fromJsonDocument* method.

B. Consider Couchbase write behavior

8. Run the *lab-07* project. You should see this console output:



9. In the Couchbase administration console, open the *customer360* data bucket, and use the *Look Up ID* tool to find the *customer::rred33* document, inserted in a prior Lab.



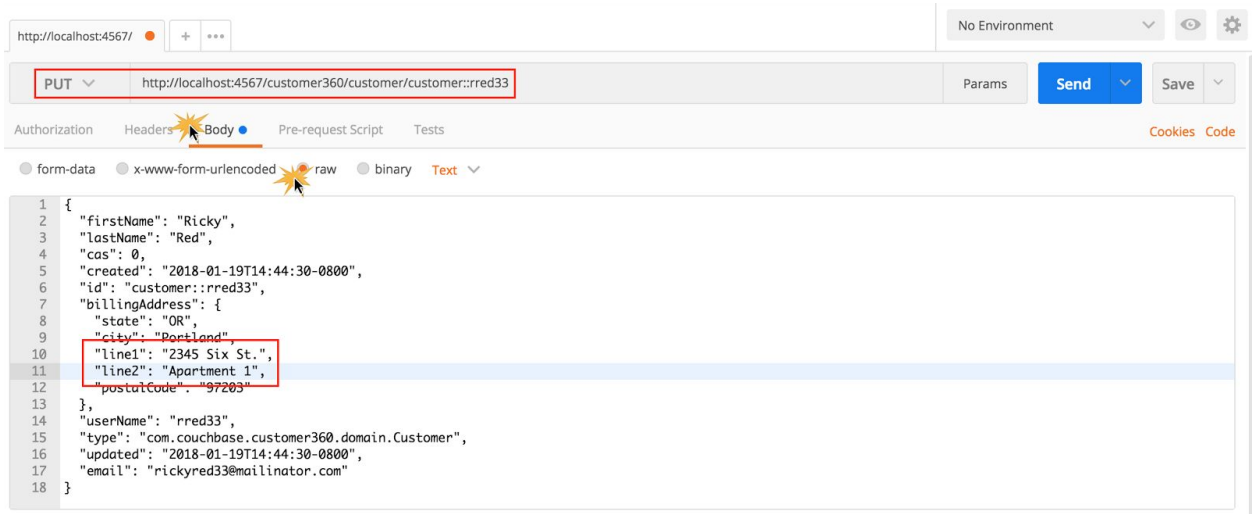
10. Copy the value of the *customer::rred33* document.

11. With the Lab application running, launch your REST API tool, and configure this PUT request to retrieve the document:

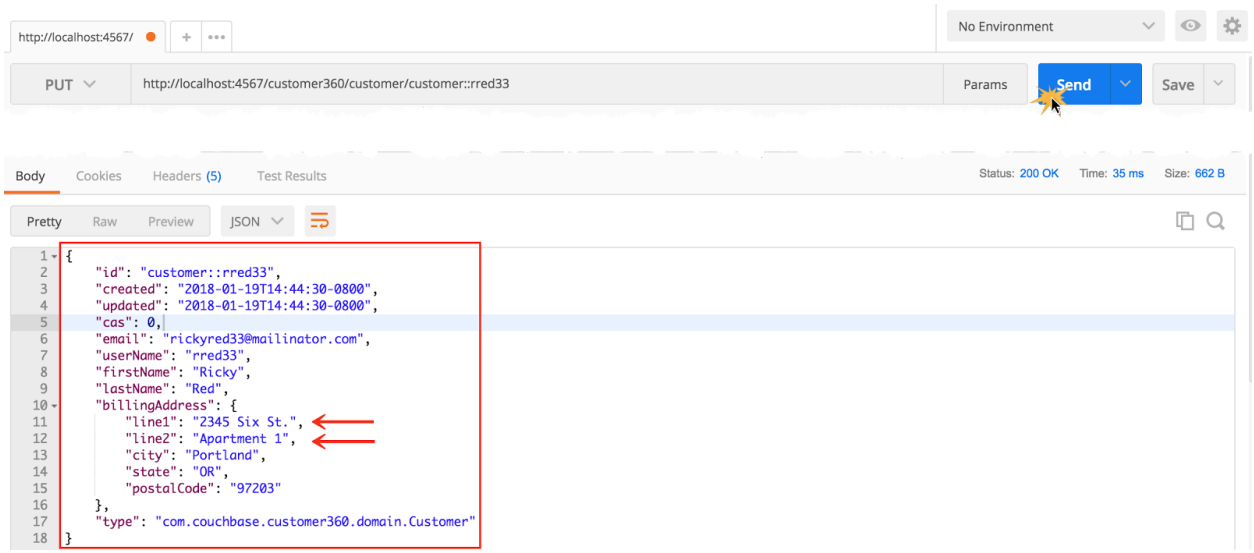
    - ❏ HTTP Verb (Method): PUT
    - ❏ URL for SparkJava: *http://localhost:4567*
    - ❏ Base application URL: */customer360*
    - ❏ Controller extension: */customer*
    - ❏ Document ID: *customer::rred33*

    `http://localhost:4567/customer360/customer/customer::rred33`

12. Paste the copied document in the Request Body Content field.
13. In the Body Content field, modify “line1” to a different value, and add a “line2” value.



14. Send the request, and examine the modified document returned in the response.



15.

16. Configure and send a GET request for the same document. You should once again see the replaced ("updated") values.

    `http://localhost:4567/customer360/customer/customer::rred33`

17. Configure and send a new PUT request to update a non-existing document, using the following settings.

    - ❏ HTTP Verb (Method): PUT
    - ❏ URL for SparkJava: *http://localhost:4567*
    - ❏ Base application URL: */customer360*
    - ❏ Controller extension: */customer*
    - ❏ Document ID: ***customer::kkohl44***

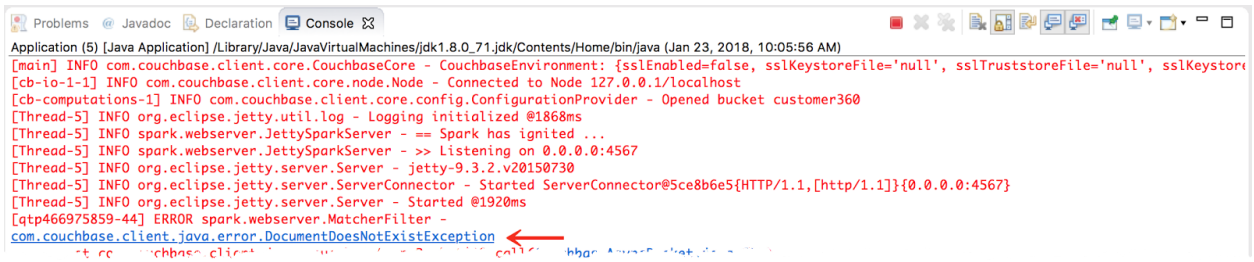
    `http://localhost:4567/customer360/customer/customer::kkohl44`

    Body Content (note, you can copy and paste this code from this document):

    ```
    {
      "id" : "customer::kkohl44",
      "firstName" : "Krishna",
      "lastName" : "Kohl"
    }
    ```

    Note, due to the way this particular application handles incoming URLs and JSON, you must add a document here, with (at least) an ID value. The ID value is written into the *JsonDocument* passed to the *replace* operation.

18. In Eclipse, you should see a *DocumentDoesNotExistException*. You cannot update a non-existent document. While this is expected, it adds complexity. The client must know whether a record exists to determine whether to insert or update it.

    Note, while the code in *lab-07* is not configured to handle exceptions, it is easy to do so. Examine and run the corresponding code in the *lab-final* project, which does handle and report exceptions, including this exception, through the REST API.

19. Stop the running application.

End of lab

Lab 8 - Upsert (insert or replace) a document

Objectives

A	Insert or replace a document in a single operation
B	Modify the *customer360* application API to accommodate *upsert* logic
C	Observe the behavior of multiple PUT operations for the same document

In this lab, you modify the current application logic - which either inserts ("creates") or replaces ("updates") a document - with a single operation that handles both. This is possible, because of the append-only nature of Couchbase write operations.

A. Insert or replace ("update") a document in a single upsert operation

1. In Eclipse, open the *lab-08* project, and close unrelated projects.
2. In *CouchbaseRepository.java*, locate the *upsert* method, review its signature, and delete the *TODO* and placeholder exception. Notice the method receives a Java domain object, named *entity*, along with a reference to its *type*.

```
public <T extends Entity> T upsert(T entity, Class<? extends T> type) {

}
```

3. Use the *toJsonDocument* method to convert the entity passed to this method into a *JsonDocument*, named *docIn*.

```
public <T extends Entity> T upsert(T entity, Class<? extends T> type) {
	JsonDocument docIn = toJsonDocument(entity);

}
```

4. (Optional) Review the *toJsonDocument* method.
5. Pass *docIn* to the *upsert* method of the *bucket*, and assign the result to a *JsonDocument* named *docOut*.

```
public <T extends Entity> T upsert(T entity, Class<? extends T> type) {
	JsonDocument docIn = toJsonDocument(entity);
	JsonDocument docOut = bucket.upsert(docIn);

}
```

6. Use the *fromJsonDocument* method to convert *docOut* back to a Java domain object of the specified *type*, and *return* the result from the method.

```
public <T extends Entity> T upsert(T entity, Class<? extends T> type) {
	JsonDocument docIn = toJsonDocument(entity);
	JsonDocument docOut = bucket.upsert(docIn);
	return fromJsonDocument(docOut, type);
}
```

7. (Optional) Review the *fromJsonDocument* method.

B. Modify the customer360 application API to accommodate upsert logic

8. In *BaseController.java*, modify the logic handling POST requests to call *upsert* method of the *CouchbaseRepository* instance named *repo*, rather than its *create* method.

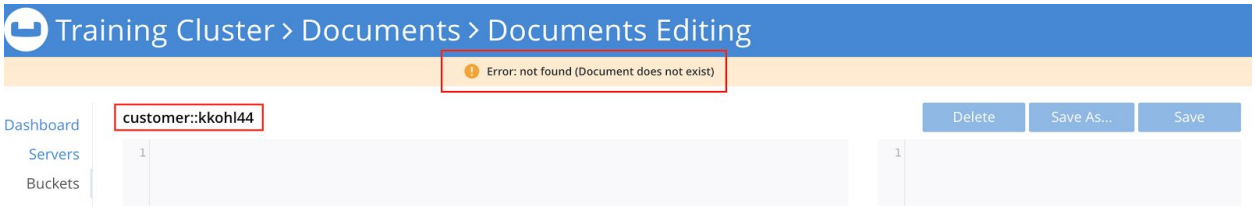
```
if(!methodList.contains(HttpMethod.post)) {
	Spark.post(baseURL, new Route() {
		@Override
		public Object handle(Request request, Response response) {
			T entity = converter.fromJson(request.body(), type);
			contentLocation(response, baseURL + "/" + entity.getId());
			// T result = repo.create(entity, type);
			T result = repo.upsert(entity, type);
			return ok(response, result);
		}
	});
}
```

9. Modify the logic handling PUT requests to call the *upsert* method of the *CouchbaseRepository* instance named *repo*, rather than its *create* method.

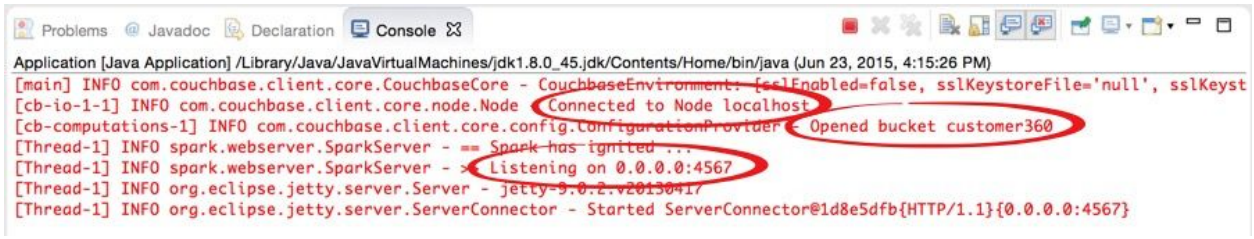
```
if(!methodList.contains(HttpMethod.put)) {
	Spark.put(baseURL + "/:id", new Route() {
		@Override
		public Object handle(Request request, Response response) {
			T entity = converter.fromJson(request.body(), type);
			if(!request.params(":id").equals(entity.getId())) {
				response.body("Invalid ID specified");
				return error(response, HttpStatus.BAD_REQUEST_400);
			}
			contentLocation(response, baseURL + "/" + entity.getId());
			// T result = repo.update(entity, type);
			T result = repo.upsert(entity, type);
			return ok(response, result);
		}
	});
}
```

C. Observe the behavior of multiple PUT operations for the same document

10. In the Couchbase administration console, look up *customer::kkohl44* to verify this document was <u>not</u> accidentally added in the prior lab. If so, delete it.



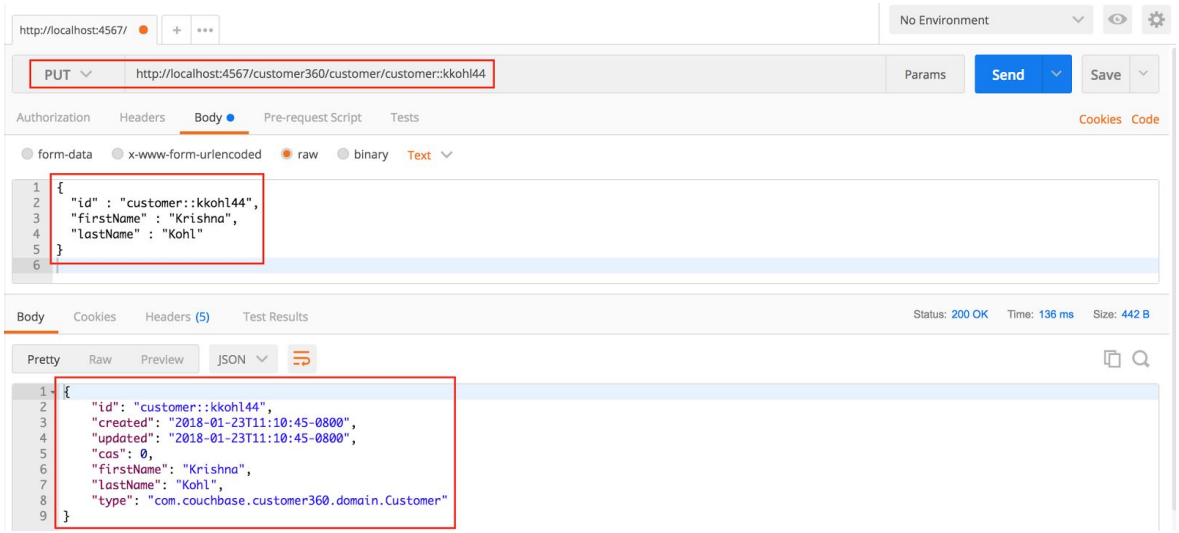
11. Run the *lab-08* project. You should see this console output:



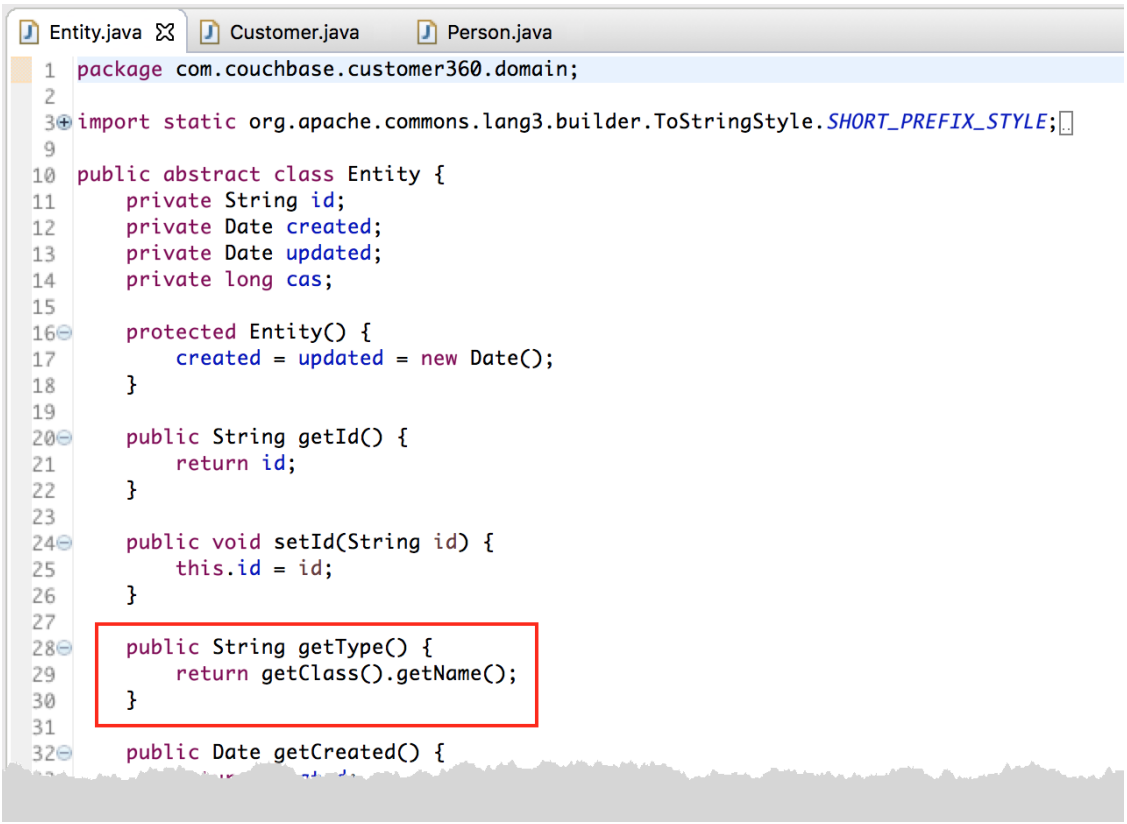
12. In your REST API tool, configure and send the same PUT request - to update a non-existing document - which threw an exception in *lab-07*. Because this document does not yet exist, this request now creates it.

```
http://localhost:4567/customer360/customer/customer::kkohl44
```

```
{
  "id" : "customer::kkohl44",
  "firstName" : "Krishna",
  "lastName" : "Kohl"
}
```



13. (Optional) Open and briefly review the *Customer.java*, *Person.java*, and *Entity.java* classes. Recall the *toJsonDocument* method in *CouchbaseRepository.java*, and consider how the *type* value became part of the *customer360* documents.



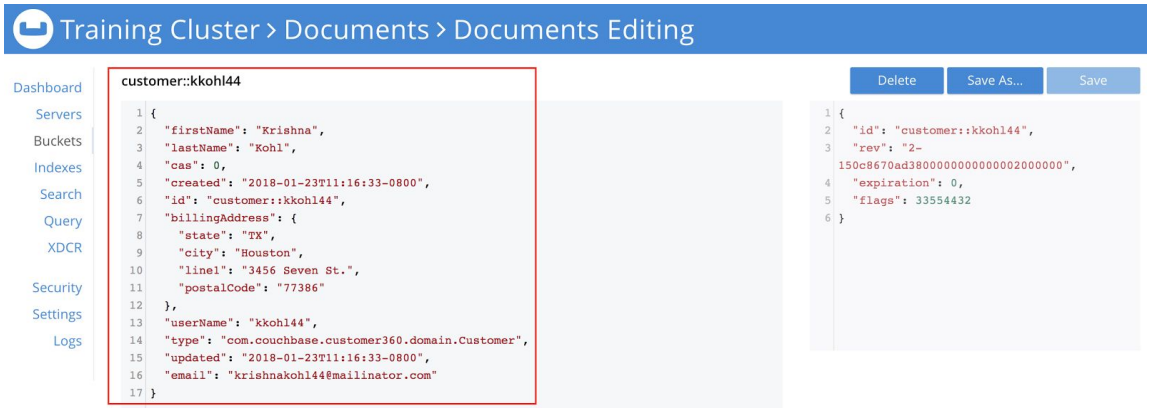
Note, a document is any binary value up to 20mb. Structure and content are up to you.

14. In HTTP Tool, modify the Body Content of the prior PUT request to add additional fields, then submit the request.

```
http://localhost:4567/customer360/customer/customer::kkohl44
```

```
{
  "id": "customer::kkohl44",
  "email": "krishnakohl44@mailinator.com",
  "userName": "kkohl44",
  "firstName": "Krishna",
  "lastName": "Kohl",
  "billingAddress":
    {
      "line1": "3456 Seven St.",
      "city": "Houston",
      "state": "TX",
      "postalCode": "77386"
    }
}
```

15. In the Couchbase UI, open the *customer360* data bucket, locate and open (or refresh the view of) the newly added document. Notice the same PUT operation now creates or updates the document, as appropriate.



16. Stop the running application.

End of lab

Lab 9 - Remove (“delete”) a document

Objectives

A	Remove an existing document
B	Observe the behavior when attempting to remove a non-existing document

In this lab, you implement and test the code to remove an existing document. You also observe the exception thrown when attempting to remove a non-existing document.

Note, in the *lab-09* project, the code has been restored to its state in *lab-07*. You must issue a POST request to insert (“create”) a document, and a PUT request to replace (“update”) it.

A. Remove an existing document

1. In Eclipse, open the *lab-09* project, and close unrelated projects.
2. In *CouchbaseRepository.java*, locate the *delete* method, review its signature, and delete the *TODO* and placeholder exception. Notice the method receives a Java domain object, named *entity* but, unlike related methods, no reference to its *type*.

```
public <T extends Entity> void delete(T entity) {

}
```

3. Convert the *entity* passed to the *delete* method to a *JsonDocument*.

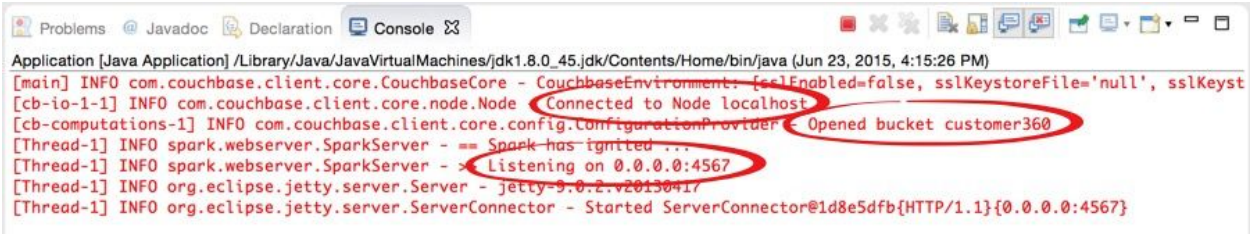
```
public <T extends Entity> void delete(T entity) {
       JsonDocument doc = toJsonDocument(entity);

}
```

4. Use the *remove* method of the *bucket* reference to “delete” this document.

```
public <T extends Entity> void delete(T entity) {
       JsonDocument doc = toJsonDocument(entity);
       bucket.remove(doc);
}
```

   Recall from the video discussion that documents are marked for removal (“tombstoned”), and rendered immediately unavailable. However, they are not physically removed until the next compaction.

5. Run the *lab-09* project. You should see this console output:

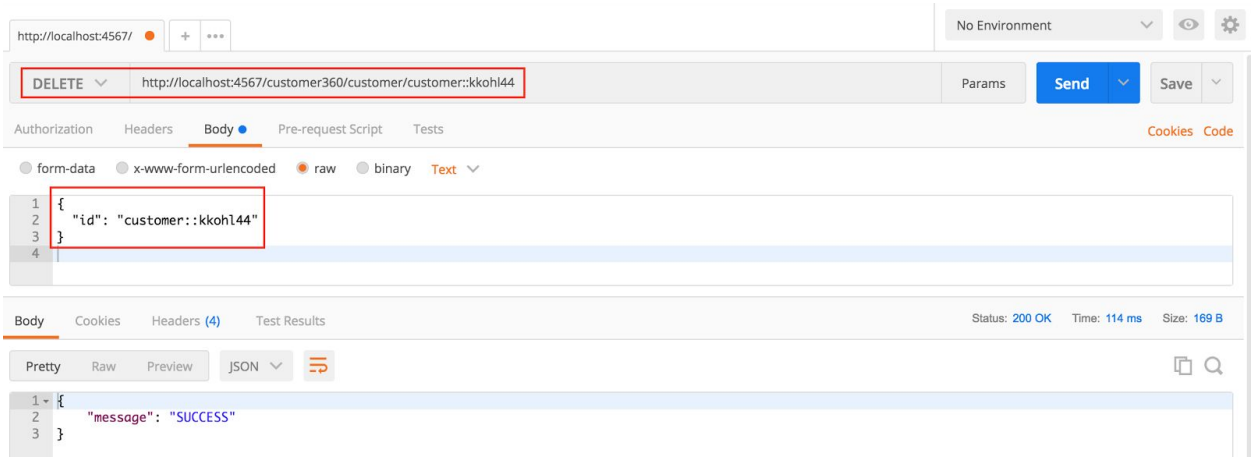


6. In your REST API tool, send a DELETE request for a document with ID *customer::kkohl44*. The customer360 app should return a success message.

```
http://localhost:4567/customer360/customer/customer::kkohl44
```

Body Content:

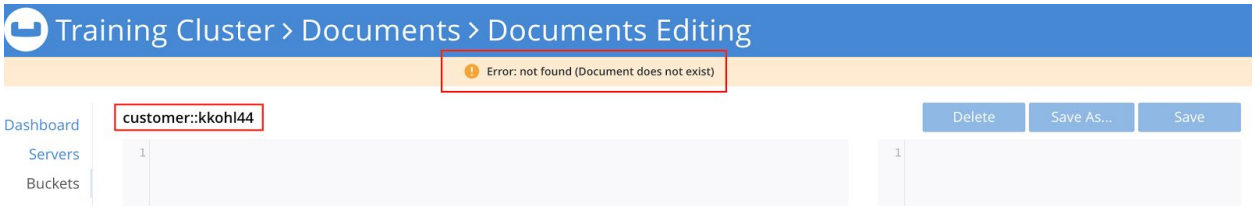
```
{
  "id": "customer::kkohl44"
}
```



Note, the particular REST API implemented in this code requires the ID on the URL, or not, as specified in *BaseController.java*. However, the Couchbase SDK only requires the ID of the *JsonDocument* passed through it to Couchbase Server. Ultimately, you'll decide how to implement your own API.

Note, you could also simply call *bucket.remove(id)*, passing only the document ID itself.

7. In the Couchbase administration console, open the *customer360* data bucket and look up the *customer::kkohl44* document to verify it has been removed.



B. Observe the behavior when attempting to remove a non-existing document

8. In HTTP Tool, submit the DELETE request for *customer::kkohl44* a second time.
9. In Eclipse, you should see a *DocumentDoesNotExistException*.

9. Stop the running application.

End of Lab

Lab 10 - Implement and use a cluster-wide counter

Objectives

A	Implement a counter
B	Use a counter to create unique keys
C	Observe auto-incremented ID values

In this lab, you implement a counter, and related code, to generate unique keys following a similar pattern to that used for the manually created keys earlier in this course. The Java domain type is used, followed by a counter value generated atomically by Couchbase server.

A. Implement a named counter

1. In Eclipse, open the *lab-10* project, and close unrelated projects.
2. In *CouchbaseRepository.java*, locate the *getNextId* method, review its signature, read and remove its TODO and placeholder exception. Notice that it receives a *type*, an initial value, and a value by which to increment. Do not delete the assignment of the modified simple name of the *type* to a local String variable called *name*.

```
private <T extends Entity> String getNextId(Class<T> type, long incr,
       long init) {
       String name = type.getSimpleName().toLowerCase();

}
```

3. Use the *counter* method of the *bucket* to create a new counter, concatenating the literal prefix *"counter::"* to the *name* variable..
4. Pass the increment parameter, *incr*, to set how the value will change with each use.
5. Pass the initial value parameter, *init*, to initialize the counter if it does not yet exist.
6. Assign the result to a local *JsonLongDocument* variable named *doc*.

```
private <T extends Entity> String getNextId(Class<T> type, long incr,
       long init) {
       String name = type.getSimpleName().toLowerCase();
       JsonLongDocument doc =
              bucket.counter("counter::" + name, incr, init);

}
```

7. Extract the counter value from the *content* of *doc*, as a *String*, and combine it with the *name* variable, followed by the literal "::".
8. *Return* this value from the method.

```
private <T extends Entity> String getNextId(Class<T> type, long incr,
        long init) {
        String name = type.getSimpleName().toLowerCase();
        JsonLongDocument doc =
                bucket.counter("counter::" + name, incr, init);
        return name + "::" + doc.content().toString();
}
```

B. Use a counter to create unique keys

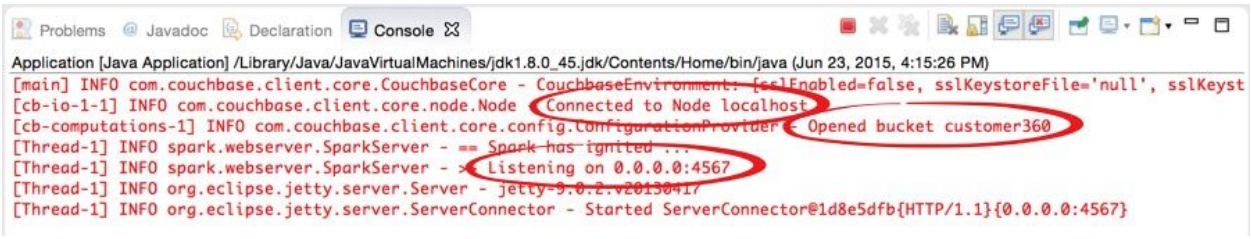
9. In the *create* method - above the existing code converting and inserting the *entity* - review the pre-written condition, using the *isBlank* method, to test whether an *ID* has been assigned to the entity being passed into this method for creation.

```
public <T extends Entity> T create(T entity, Class<? extends T> type) {
        if(isBlank(entity.getId())) {

        }
        JsonDocument docIn = toJsonDocument(entity);
        JsonDocument docOut = bucket.insert(docIn);
        return fromJsonDocument(docOut, type);
}
```

10. If the *entity* has not been assigned an *ID*, use the *getNextId* method to get the next atomically unique value for this Java domain type, specifying *1* as the increment value, and *100* as the initial value, if the counter does not yet exist.
11. Set this new value as the *ID* for this entity.

```
public <T extends Entity> T create(T entity, Class<? extends T> type) {
        if(isBlank(entity.getId())) {
                String id = getNextId(type, 1, 100);
                entity.setId(id);
        }
        JsonDocument docIn = toJsonDocument(entity);
        JsonDocument docOut = bucket.insert(docIn);
        return fromJsonDocument(docOut, type);
}
```

12. Run the *lab-010* project. You should see this console output:



C. Observe auto-incremented ID values

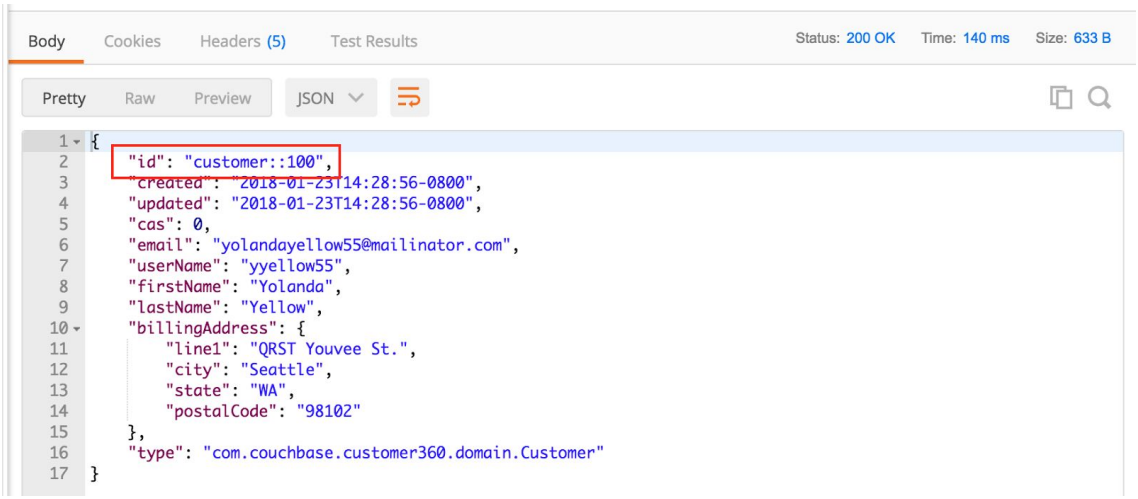
13. In your REST API tool, POST the following document, which has no ID:

    `http://localhost:4567/customer360/customer`

    Body Content:

```
{
    "email": "yolandayellow55@mailinator.com",
    "userName": "yyellow55",
    "firstName": "Yolanda",
    "lastName": "Yellow",
    "billingAddress": {
        "line1": "QRST Youvee St.",
        "city": "Seattle",
        "state": "WA",
        "postalCode": "98102"
    }
}
```

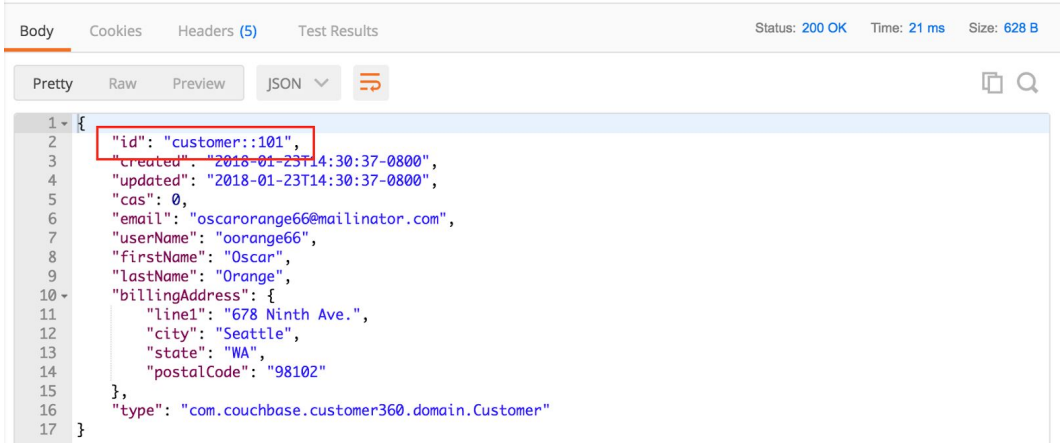
14. You should see the following copy of the newly inserted document, returned in response.



15. Modify the request body, to post a second document (if re-using the prior document, be sure to remove the ID value).

```
{
    "email": "oscarorange66@mailinator.com",
    "userName": "oorange66",
    "firstName": "Oscar",
    "lastName": "Orange",
    "billingAddress": {
        "line1": "678 Ninth Ave.",
        "city": "Seattle",
        "state": "WA",
        "postalCode": "98102"
    }
}
```

16. You should see the new document in the response, with an ID incremented from the previously posted document.



17. In the Couchbase administration console, open the *customer360* data bucket, and look up the *counter::customer* document, and its value (the actual counter value you see may vary, depending on how many documents you ultimately posted).

18. Stop the running application.

End of Lab

Lab 11 - Implement optimistic locking using CAS

Objectives

A	Implement optimistic locking by tracking CAS values on client
B	Test the behavior seen when attempting to change a locked document

In this exercise, you cause CAS values to be persisted as Java domain types are converted to and from the JsonDocument type. You then test how locked document

A. Implement optimistic locking by tracking CAS values on client

1. In Eclipse, open the *lab-11* project, and close unrelated projects.
2. In *CouchbaseRepository.java*, locate the *toJsonDocument* method, review its signature and existing code, remove the TODO comment, and comment out the line which creates the *JsonDocument*, named *doc*, from the Java domain object passed in as *source*.
3. Modify the *toJsonDocument* method to pass the CAS value of the Java domain object passed to this method for conversion, to the *JsonDocument.create* factory method, in addition to the *ID* and *content*.

```
protected <T extends Entity> JsonDocument toJsonDocument(T source) {
  if (source == null) {
    throw new IllegalArgumentException("entity is null");
  }
  String id = source.getId();
  if (id == null) {
    throw new IllegalStateException("entity ID is null");
  }
  try {
    JsonObject content =
      transcoder.stringToJsonObject(converter.toJson(source));
    // JsonDocument doc = JsonDocument.create(id, content);
    JsonDocument doc = JsonDocument.create(id, content, source.getCas());
    return doc;
  } catch (Exception e) {
    throw new RepositoryException(e);
  }
}
```

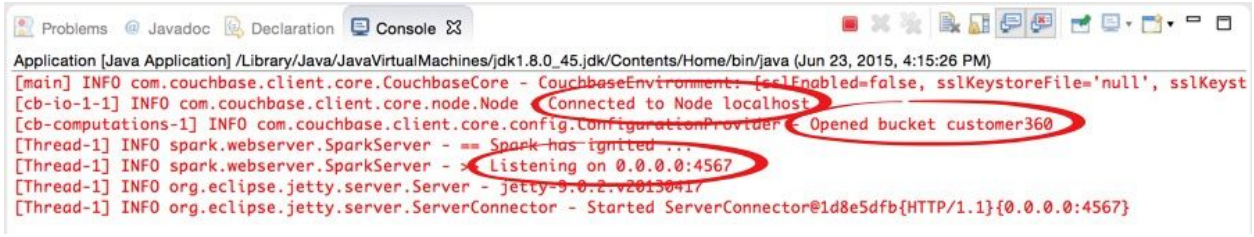
4. Locate the *fromJsonDocument* method, review its signature and existing code, and remove the TODO comment.

5. Use the *setCas* method of the *result* object to assign this object the CAS value of the *JsonDocument* being passed to this method for conversion back to a Java domain type.

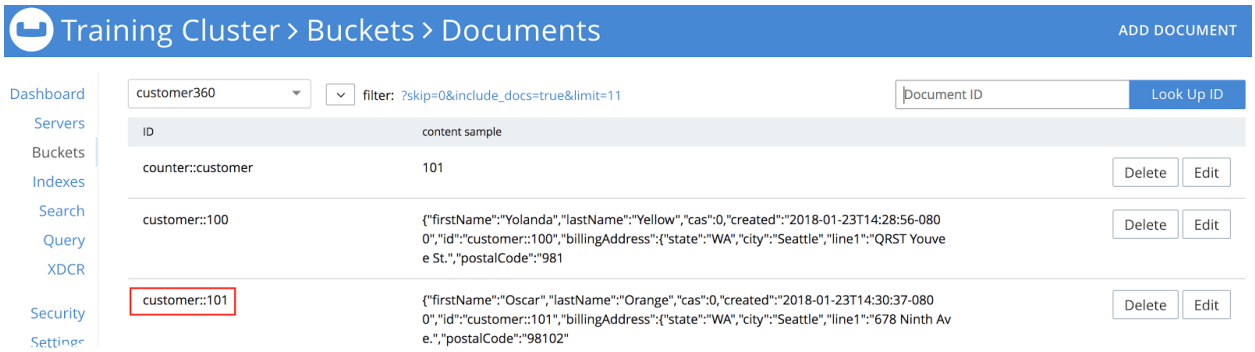
```
protected <T extends Entity> T fromJsonDocument(JsonDocument doc,
  Class<T> type) {
        if (doc == null) {
              throw new IllegalArgumentException("document is null");
        }
        JsonObject content = doc.content();
        if (content == null) {
              throw new IllegalStateException("document has no content");
        }
        if (type == null) {
              throw new IllegalArgumentException("type is null");
        }
        T result = converter.fromJson(content.toString(), type);
        result.setCas(doc.cas());
        return result;
}
```

B. Test the behavior seen when attempting to change a locked document

6. Run the *lab-11* project. You should see this console output:

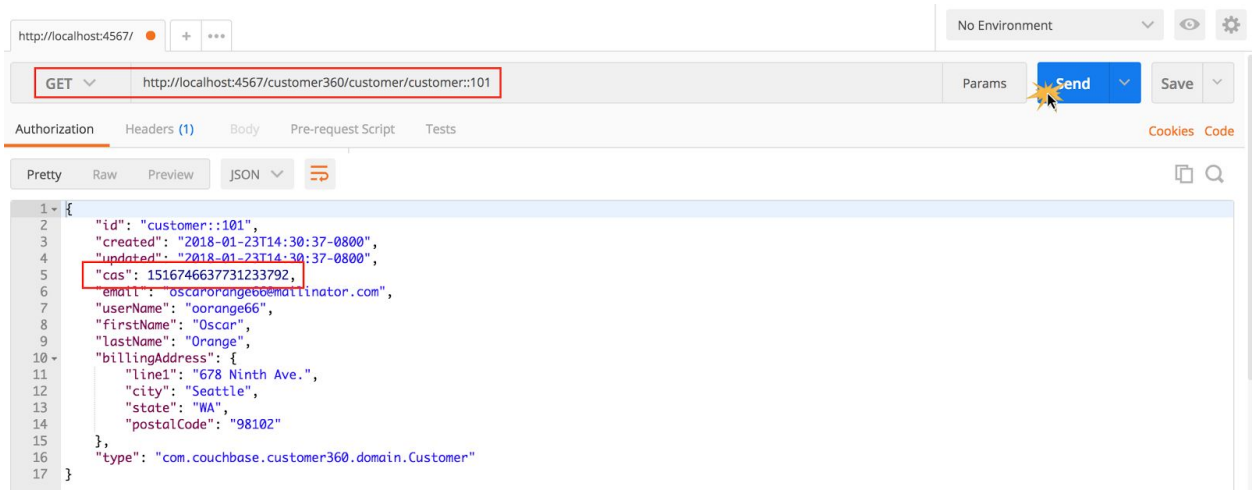


7. In the Couchbase administration console, open the *customer360* data bucket, and note the ID of one of the documents generated in the prior exercise.



8. In your REST API tool, GET the document using its document ID.

```
http://localhost:4567/customer360/customer/customer::101
```



Notice that, due to the code modified above, the CAS value now being persisted in the client code (e.g., *JsonDocument*) is also written into the document. Normally, CAS is present only as metadata within the *JsonDocument* object, and in Couchbase server.

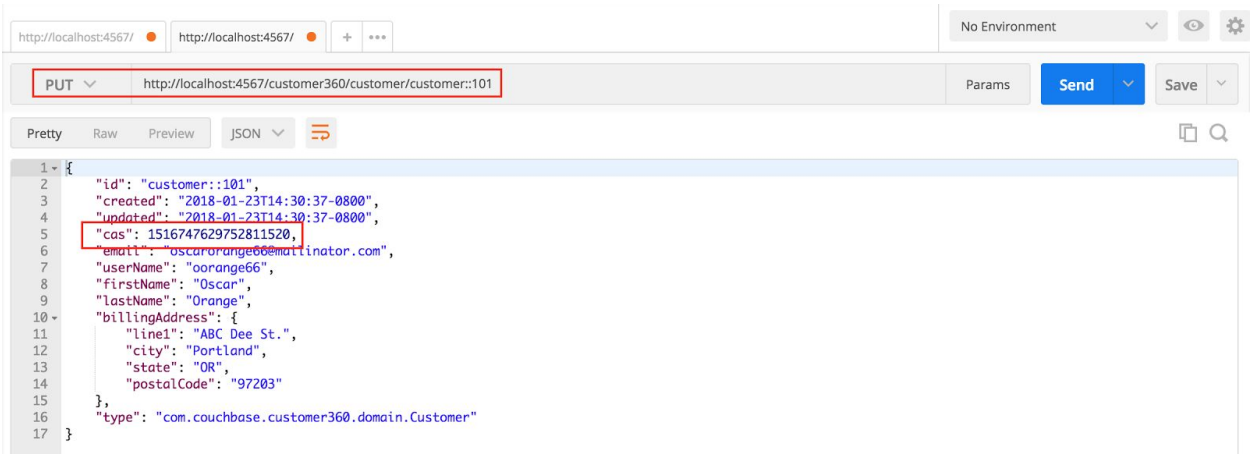
9. Copy the response body. Then, to simulate a second client, leave the first tab open, and open a second tab in your REST API tool.
10. Paste the copied document in the request body field, modify the *billingAddress* to different values. PUT the change to update the document.

    Note, **do not change the CAS value**, as it represents the current version of this document. Without it, or with a different value, this replace operation will fail.

```
http://localhost:4567/customer360/customer/customer::101
```

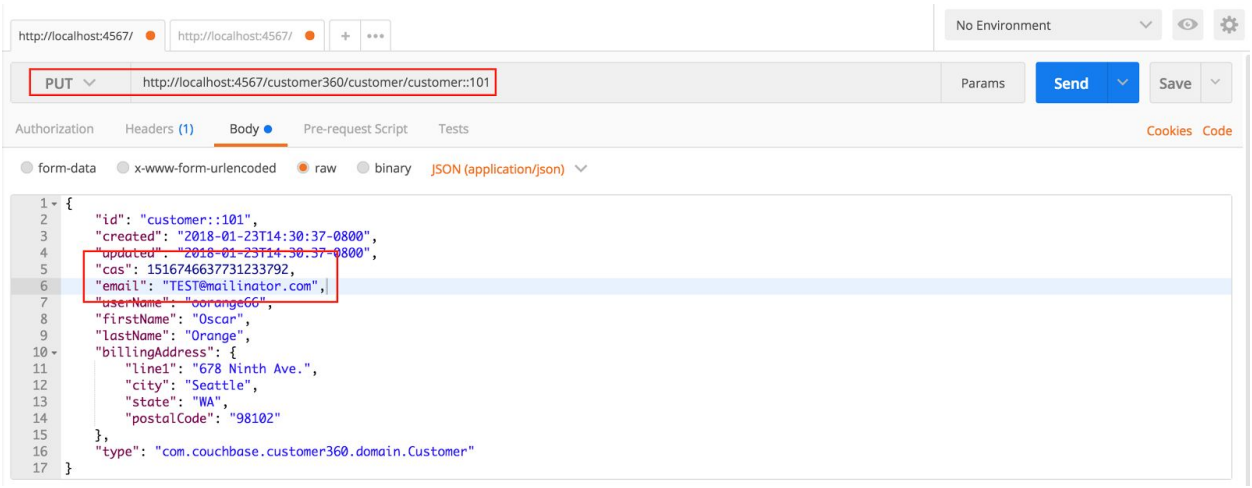
```
{
    "id": "customer::101",
    "created": "2015-06-30T16:01:13-0700",
    "updated": "2015-06-30T16:01:13-0700",
    "cas": [do not change this value],
    "email": "oscarorange66@mailinator.com",
    "userName": "oorange66",
    "firstName": "Oscar",
    "lastName": "Orange",
    "billingAddress": {
        "line1": "ABC Dee St.",
        "city": "Portland",
        "state": "OR",
        "postalCode": "97203"
    },
    "type": "com.couchbase.customer360.domain.Customer"
}
```

11. In the Response Body Content, you should see the changed values, along with a new CAS and updated timestamp.

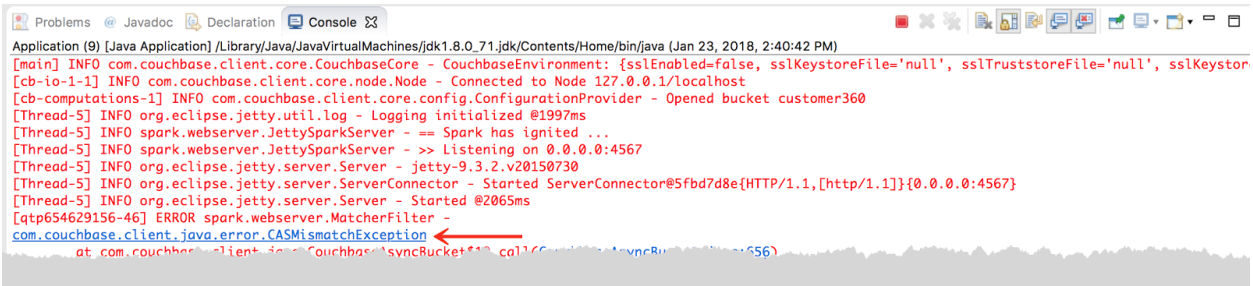


12. Return to the first browser tab. Copy the response body (from the original GET) into the request body, modify the email name to “TEST”, and PUT the change.

    Note, because the prior PUT/replace changed the CAS value, this CAS value no longer matches the current state of the document in Couchbase.



13. In Eclipse, notice the *CASMismatchException* in the Console.



14. (Optional) Open the *lab-final* project, and review the *update* method in *CouchbaseRepository.java*, to see how this exception could be handled and reported back via the REST API.
15. Close the running application.

End of lab