# MarkLogic Server

## Java Application Developer's Guide

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# Table of Contents

## Java Application Developer's Guide


1.0 Introduction to the Java API ..... 7
- 1.1 Java API or Java XCC? ..... 8
- 1.2 Getting Started ..... 8
  - 1.2.1 Make the Libraries Available to Your Application ..... 8
  - 1.2.2 Create a REST API Instance ..... 9
  - 1.2.3 Create Users ..... 9
  - 1.2.4 Explore the Examples ..... 10
- 1.3 Creating, Working With, And Releasing a Database Client ..... 10
  - 1.3.1 Creating a Database Client ..... 10
  - 1.3.2 Working With a Database Client ..... 11
  - 1.3.3 Releasing a Database Client ..... 11
- 1.4 A Basic "Hello World" Method ..... 11
- 1.5 Document Managers ..... 12
- 1.6 Streaming ..... 13
- 1.7 Handles ..... 13
- 1.8 Thread Safety of the Java API ..... 15

2.0 Document Operations ..... 16
- 2.1 Document Creation ..... 16
  - 2.1.1 Writing an XML Document To The Database ..... 17
  - 2.1.2 Creating a Text Document In the Database ..... 18
  - 2.1.3 Automatically Generating Document URIs ..... 18
- 2.2 Document Deletion ..... 20
- 2.3 Reading Document Content ..... 20
- 2.4 Format-Specific Operations ..... 21
- 2.5 Writing A Binary Document ..... 22
- 2.6 Reading Content From A Binary Document ..... 22
- 2.7 Reading, Modifying, and Writing Metadata ..... 22
  - 2.7.1 Document Metadata ..... 23
  - 2.7.2 Reading Document Metadata ..... 23
  - 2.7.3 Collections Metadata ..... 24
  - 2.7.4 Properties Metadata ..... 25
  - 2.7.5 Quality Metadata ..... 26
  - 2.7.6 Permissions Metadata ..... 26
  - 2.7.7 Manipulating Document Metadata In Your Application ..... 27
  - 2.7.8 Writing Metadata ..... 27
- 2.8 Conversion of Document Encoding ..... 27
- 2.9 Partially Updating Document Content and Metadata ..... 30

2.9.1 Introduction to Content and Metadata Patching ....31
2.9.2 Basic Steps for Patching Documents and Metadata ....32
2.9.3 Construct a Patch From Raw XML or JSON ....33
2.9.4 Defining the Context for a Patch Operation ....35
2.9.5 Managing XML Namespaces in a Patch ....35
2.9.5.1 Defining Namespaces With a Builder ....35
2.9.5.2 Defining Namespaces in Raw XML ....36
2.9.6 Construct Replacement Data on the Server ....37

3.0 Searching ....39
3.1 Overview of Search Using the Java API ....39
3.2 Using SearchHandle to Examine Query Results ....40
3.3 Search Using String Query Definition ....41
3.4 Search Documents Using Key-Value Query Definition ....42
3.4.1 JSON Key-Value Searches ....42
3.4.2 XML Key-Value Searches ....43
3.5 Search Documents Using Structured Query Definition ....43
3.5.1 Ways to Create a Structured Query ....43
3.5.2 Basic Steps to Define a Structured Query Definition ....44
3.5.3 Creating a Structured Query From Raw XML or JSON ....44
3.5.4 Structured Query Examples ....46
3.5.4.1 Example: Date Range Structured Query ....47
3.5.4.2 Example: Element Index Structured Query ....47
3.5.4.3 Example: Property Value Structured Query ....48
3.5.4.4 Example: Property Value Structured Query ....48
3.5.4.5 Example: Document Structured Query ....49
3.5.4.6 Example: Collection Structured Query ....49
3.6 Prototype a Query Using Query By Example ....49
3.6.1 What is QBE ....50
3.6.2 Search Documents Using a QBE ....51
3.6.3 Validate a QBE ....52
3.6.4 Convert a QBE to a Combined Query ....52
3.7 Apply Dynamic Query Options to Document Searches ....53
3.7.1 Creating a Combined Query ....53
3.7.2 Interaction with Persistent Query Options ....55
3.7.3 Performance Considerations ....56
3.8 Search On Tuples (Tuples Query / Values Query) ....56
3.8.1 Values Search ....57
3.8.2 Tuples Search ....57
3.9 Limiting A Search To Specific Collections And/Or A Directory ....58
3.10 Transforming Search Results ....58
3.10.1 Writing a Search Result Transform ....58
3.10.2 Using a Search Result Transform ....59
3.11 ....Generating Search Term Completion Suggestions 59
3.11.1 Basic Steps ....60
3.11.2 Example: Generating Search Suggestions ....61

3.11.2.1 Initialize the Database ....61
3.11.2.2 Install Query Options ....62
3.11.2.3 Get Search Suggestions ....63
3.11.3 Where to Find More Information ....63

4.0 Query Options ....64
4.1 Using Query Options ....64
4.2 Default Query Options ....65
4.3 Using QueryOptionsManager To Delete, Write, and Read Options ....65
4.4 Using Query Options With Search ....66
4.5 Using QueryOptionsBuilder ....67
4.6 Creating Persistent Query Options From Raw JSON or XML ....68
4.7 Validating Query Options With setQueryOptionValidation() ....70

5.0 Alerting ....71
5.1 Alerting Pre-Requisites ....71
5.2 Alerting Concepts ....71
5.3 Defining Alerting Rules ....72
5.3.1 Defining a Rule Using RuleDefinition ....72
5.3.2 Defining a Rule in Raw XML ....73
5.3.3 Defining a Rule in Raw JSON ....75
5.4 Testing for Matches to Alerting Rules ....76
5.4.1 Basic Steps ....77
5.4.2 Identifying Input Documents Using a Query ....77
5.4.3 Identifying Input Documents Using URIs ....78
5.4.4 Matching Against a Transient Document ....78
5.4.5 Filtering Match Results ....79
5.4.6 Transforming Alert Match Results ....79
5.4.6.1 Writing a Match Result Transform ....79
5.4.6.2 Using a Match Result Transform ....80

6.0 Transactions and Optimistic Locking ....81
6.1 Multi-Statement Transactions ....81
6.1.1 Transactions and the Java API ....81
6.1.2 Transaction Class ....82
6.1.3 Starting A Transaction ....83
6.1.4 Operations Inside A Transaction ....83
6.1.5 Rolling Back A Transaction ....84
6.1.6 Committing A Transaction ....84
6.1.7 Cookbook: Multistatement Transaction ....84
6.1.8 Transaction Management When Using a Load Balancer ....84
6.2 Optimistic Locking ....85
6.2.1 Activating Optimistic Locking ....85
6.2.2 DocumentDescriptors ....86
6.2.3 Using Optimistic Locking ....86

6.2.4 Cookbook: Version Control and Optimistic Locking ....87

7.0 Logging ....88
7.1 Starting Logging ....88
7.2 Suspending and Resuming Logging ....88
7.3 Stopping Logging ....89
7.4 Log Entry Format ....89
7.5 Logging To The Server's Error Log ....89

8.0 REST Server Configuration ....90
8.1 Creating a Server Configuration Manager Object ....90
8.2 Reading and Writing Server Configuration Properties ....90
8.3 REST Server Properties ....91
8.4 Creating New Server-Related Manager Objects ....91
8.5 Namespaces ....92
8.5.1 Namespaces Manager ....93
8.5.2 Getting Server Defined Namespaces ....93
8.5.3 Adding And Updating A Namespace Prefix ....93
8.5.4 Reading Prefixes ....94
8.5.5 Deleting Prefixes ....94
8.6 Logging Namespace Operations ....95

9.0 Content Transformations ....96
9.1 Installing Transforms ....96
9.2 Using Transforms ....97
9.2.1 Transforming a Document When Reading It ....97
9.2.2 Transforming a Document When Writing It ....98
9.2.3 Transforming Search Results ....99
9.2.4 Transforming Alert Match Results ....99
9.2.5 Overall Transform Administration ....100
9.2.6 Reading Transforms ....100
9.2.7 Logging ....100
9.3 Writing Transformations ....100

10.0 Extending the Java API ....101
10.1 Introduction to Extending the Java API ....101
10.2 Creating a Resource Extension in XQuery ....102
10.3 Installing Resource Extensions ....102
10.4 Deleting Resource Extensions ....104
10.5 Listing Resource Extensions ....104
10.6 Using Resource Extensions ....104
10.7 Managing Dependent Libraries and Other Assets ....107
10.7.1 Maintenance of Dependent Libraries and Other Assets ....107
10.7.2 Installing or Updating Assets ....107

10.7.3 Removing an Asset ....108
10.7.4 Retrieving an Asset List ....109
10.7.5 Retrieving an Asset ....109

11.0 Troubleshooting ....110
11.1 Error Detection ....110
11.2 General Troubleshooting Techniques ....110

12.0 Technical Support ....112

Combined Product Notices ....113
COPYRIGHT ....113
TRADEMARK NOTICE ....190

# 1.0 Introduction to the Java API

The Java Client API is an open source API for creating applications that use MarkLogic Server for document and search operations. Developers can easily take advantage of the advanced capabilities for persistence and search of unstructured documents that MarkLogic Server provides. The capabilities provided by the JAVA API include:

- Insert, update, or remove documents and document metadata. For details, see “Document Operations” on page 16.
- Query text and lexicon values. For details, see “Searching” on page 39.
- Configure persistent and dynamic query options. For details, see “Query Options” on page 64.
- Apply transformations to new content and search results. For details, see “Content Transformations” on page 96.
- Extend the Java API to expose custom capabilities you install on MarkLogic Server. For details, see “Extending the Java API” on page 101.

When working with the Java API, you first create a manager for the type of document or operation you want to perform on the database (for instance, a `JSONDocumentManager` to write and read JSON documents or a `QueryManager` to search the database). To write or read the content for a database operation, you use standard Java APIs such as `InputStream`, DOM, StAX, JAXB, and Transformer as well as Open Source APIs such as JDOM and Jackson.

The Java API provides a handle (a kind of adapter) as a uniform interface for content representation. As a result, you can use APIs as different as `InputStream` and DOM to provide content for one `read()` or `write()` method. In addition, you can extend the Java API so you can use the existing `read()` or `write()` methods with new APIs that provide useful representations for your content.

This chapter covers a number of basic architecture aspects of the Java API, including fundamental structures such as *database clients*, *managers*, and *handles* used in almost every program you will write with it. Before starting to code, you need to understand these structures and the concepts behind them.

The MarkLogic Java Client API is built on top of the MarkLogic REST API. The REST API, in turn, is built using XQuery that is evaluated against an HTTP App Server. For this reason, you need a REST API instance on MarkLogic Server to use the Java API. For details, see “Create a REST API Instance” on page 9.

This chapter includes the following sections:

- Java API or Java XCC?
- Getting Started
- Creating, Working With, And Releasing a Database Client

- A Basic “Hello World” Method
- Document Managers
- Streaming
- Handles
- Thread Safety of the Java API

## 1.1 Java API or Java XCC?

The Java API co-exists with the previously developed Java XCC, as they are intended for different use cases.

A Java developer can use the Java API to quickly become productive in their existing Java environment, using the Java interfaces for search, facets, and document management. It is also possible to use its extension mechanism to invoke XQuery, so as both to leverage development teams XQuery expertise and to enable MarkLogic server functionality not implemented by the Java API.

XCC provides a lower-level interface for running remote or ad hoc XQuery. While it provides significant flexibility, it also has a somewhat steeper learning curve for developers who are unfamiliar with XQuery. You may want to think of XCC as being similar to ODBC or JDBC; a low level API for sending query language directly to the server, while the Java Client API is a higher level API for working with database constructs in Java.

In terms of performance, the Java API is very similar to Java XCC for compatible queries. The Java API is a very thin wrapper over a REST API with negligible overhead. Because it is REST-based, minimize network distance for best performance.

For more information about Java XCC, see the *XCC Developer's Guide*.

## 1.2 Getting Started

To get started with the Java Client API, do the following:

- Make the Libraries Available to Your Application
- Create a REST API Instance
- Create Users
- Explore the Examples

You need Java JRE 1.6 or later to use the Java Client API.

### 1.2.1 Make the Libraries Available to Your Application

You can either download a ZIP file of the Java Client API, or access the libraries from the central Maven repository.

To download a ZIP file or get the Maven repository information, go to the following URL:

http://developer.marklogic.com/products/java-api

To use the ZIP file, download the ZIP file, uncompress it to a directory of your choice. The jar files you need to add to your class path are in the `lib/` subdirectory.

To use the Maven repository, add the repository information from `developer.marklogic.com` to your Maven project POM file. For example, add the following to your `pom.xml` file:

```
<dependency>
  <groupId>com.marklogic</groupId>
  <artifactId>java-client-api</artifactId>
  <version>2.0.5</version>
</dependency>
```

The Java Client API is an open-source project, so you can also access the source and build your own library. For details, see http://github.com/marklogic/java-client-api.

### 1.2.2 Create a REST API Instance

The Java API implementation interacts with MarkLogic Server using the MarkLogic REST Client API. Therefore you must create a REST API instance in MarkLogic Server before you can run an application that uses the Java Client API.

A REST API instance includes a specially configured HTTP App Server capable of handling REST Client API requests, a content database, and a modules database.

For a step-by-step walkthrough of creating an instance using the GUI, see Create a REST API Instance in the *REST Application Developer's Guide*. For alternative methods of creation and more details, see Administering MarkLogic REST API Instances.

**Note:** Each application must use a separate modules database and REST API instance.

### 1.2.3 Create Users

You might need to create MarkLogic Server users with appropriate security roles, or give additional privileges to existing users.

Any user who reads data will need at least the `rest-reader` role and any user that writes data will need at least the `rest-writer` role.

Note that MarkLogic Server Administration is *not* exposed in Java, so operations such as creating indices, creating users, creating databases, etc. must be done via the Admin Interface or other MarkLogic Server administration tool. The server configuration component of the Java API is restricted to configuration operations on the REST instance.

REST instance configuration operations, such as setting instance properties require the `rest-admin` role. For details, see “REST Server Configuration” on page 90.

For details, see Security Requirements in the *REST Application Developer's Guide*.

### 1.2.4 Explore the Examples

The Java Client API distribution includes several examples in the `examples/` directory. The examples include the following packages:

- `com.marklogic.client.example.cookbook`: A collection of small examples of using the core features of the API, such as document operations and search. Most of the example code in this guide is drawn from the Cookbook examples.
- `com.marklogic.client.example.handle`: Examples of using handles based on open source document models, such as JDOM or Jackson. Examples of handle extensions that read or write database documents in a new way.
- `com.marklogic.client.example.extension`: A collection of extension classes and examples for manipulating documents in batches.

## 1.3 Creating, Working With, And Releasing a Database Client

In order to access a database with the Java API, you must create a client for it, specifically an instance of the `DatabaseClient` class. The `DatabaseClient` instance represents a database connection sharable across threads. This connection is stateless, except that authentication is done the first time a client interacts with the database via a Document Manager, Query Manager, or other manager. This section describes how to create a client and includes the following parts:

- Creating a Database Client
- Working With a Database Client
- Releasing a Database Client

### 1.3.1 Creating a Database Client

This section includes instructions for creating a database client, which eventually connects to the database. The client's creation configures it for connection, but does not actually connect it to the database.

Before the connection happens, you must also create a manager object, and use the manager object for an operation that needs to connect to the database, such as a read, write, or delete operation. This causes the client to make the actual connection to the database, which lasts until either it is explicitly released or it times out. If it times out, it auto-connects back to the database the next time a manager object in the application does a read, write, or delete operation.

To create a database client, use the `com.marklogic.client.DatabaseClientFactory.newClient()` method. For example:

```
DatabaseClient client = DatabaseClientFactory.newClient("myhost",
                8006, "myuser", "mypassword", Authentication.DIGEST);
```

The `host` and `port` values are those of the database. The `user` and `password` values are the user's credentials for accessing the database. `type` takes one of two values; `Authentication.BASIC` or `Authentication.DIGEST`.

`BASIC` authentication sends the password in obfuscated, but not encrypted, mode. `DIGEST` authentication encrypts passwords sent over the network.

For more information about user authentication, see Authenticating Users in the *Understanding and Using Security Guide*.

If your server is using SSL (*Secure Socket Layer*) for authentication, you *must* provide an `SSLContext` object final argument to `connect()`. SSL provides greater security than `DIGEST`. `SSLContext` instances represent a secure socket protocol implementation which acts as a factory for secure socket factories. For information about creating and working with `SSLContext` objects, see Accessing SSL-Enabled XDBC App Servers in the *Understanding and Using Security Guide*.

For even more security, you can also include a `DatabaseClientFactory.SSLHostnameVerifier` object to check if a hostname is acceptable.

### 1.3.2 Working With a Database Client

In addition to representing the connection to the database, `DatabaseClient` objects also have many factory methods for creating managers that use the connection. In particular, its methods create *document managers*, *server configuration managers*, *query managers*, *loggers*, and *transactions*. These are covered in elsewhere in this guide.

### 1.3.3 Releasing a Database Client

When you finish and want to release connection resources, use the `DatabaseClient` object's `release()` method.

```
client.release()
```

**IMPORTANT:** When you are done with a database client, be sure to release it.

## 1.4 A Basic "Hello World" Method

The following code is a basic method that creates a new document in the database.

```
public static void run(String host, int port, String user, String
                       password, Authentication authType) {

// Create the database client
DatabaseClient client = DatabaseClientFactory.newClient(host, port,
                                          user, password, authType);
```

```
// Make a document manager to work with text files.
TextDocumentManager docMgr = client.newTextDocumentManager();

// Define a URI value for a document.
String docId = "/example/text.txt";

// Create a handle to hold string content.
StringHandle handle = new StringHandle();

// Give the handle some content
handle.set("A simple text document");

// Write the document to the database with URI from docId
// and content from handle
docMgr.write(docId, handle);

// release the client
client.release();
}
```

The above code is a slightly modified version of the `run` method from the `com.marklogic.client.example.cookbook.ClientCreator` cookbook example. It, along with a number of other basic example applications for the Java API, is located in `example/com/marklogic/client/example/cookbook` directory found in the zip file containing the Java API.

## 1.5 Document Managers

Different document formats are handled by different *document manager* objects, which serve as an interface between documents and the database connection. The package `com.marklogic.client.document` includes document managers for binary, XML, JSON, and text. If you don't know the document format, or need to work with documents of multiple formats, use a generic document manager. `DatabaseClient` instances have factory methods to create a new `com.marklogic.client.document.DocumentManager` of any subtype.

```
BinaryDocumentManager binDocMgr = client.newBinaryDocumentManager();
XMLDocumentManager XMLdocMgr = client.newXMLDocumentManager();
JSONDocumentManager JSONDocMgr = client.newJSONDocumentManager();
TextDocumentManager TextDocMgr = client.newTextDocumentManager();
GenericDocumentManager genericDocMgr =
client.newGenericDocumentManager();
```

Your application only needs to create one document manager for any given type of document, no matter how many of that type of document it works with. So, even if you expect to work with, say, 1,000,000,000 JSON documents, you only need to create one `JSONDocumentManager` object.

Document managers are thread safe once initially configured; no matter how many threads you have, you only need one document manager per document type.

If you make a mistake and try to use the wrong type of document with a document manager, the result depends on the combination of types. For example, a `BinaryDocumentManager` will try to interpret the document content as binary. `JSONDocumentManager` and `XMLDocumentManager` are the most particular, since if a document is not in their format, it will not parse. Most of the time, you will get an exception error, with `FailedRequestException` the default if the manager cannot determine the document type.

## 1.6 Streaming

To stream, you supply an `InputStream` or `Reader` for the data source, not only when reading from the database but also when writing to the database. This approach allows for efficient write operations that do not buffer the data in memory. You can also use an `OutputWriter` to generate data as the API is writing the data to the database.

When reading from the database using a stream, be sure to close the stream explicitly if you do not read all of the data. Otherwise, the resources that support reading continue to exist.

## 1.7 Handles

Content handles are key to working with the Java API. They make use of the Adapter design pattern so the API can read and write a diverse and extensible set of content representations. To access document content and metadata, create a *handle object* that supports the appropriate representation. For example, `com.marklogic.client.io.DOMHandle` is a handle for DOM data.

The Java API contains many handle implementations. These classes make use of the Adapter design pattern so the API can read and write a diverse and extensible set of content representations. Handle classes are defined in the following packages:

- `com.marklogic.client.io` - Handles on standard representations such as `String`, `File`, and `DOM`. These classes can be used without additional libraries.
- `com.marklogic.extra` - Handle classes contained in this package require 3rd party libraries such as DOM4J, Jackson, and GSON. The extra libraries are not included with the Java API.

Some handles can support both read and write operations. Some handles are used for operations other than reading and writing, such as holding search results. For a complete list of handles and what they do, see the Java API JavaDoc.

> **Note:** Handles are *not* thread safe. Whenever you create a new thread, you will have to also create new handle objects to use while in that thread.

Some handles, unlike document managers, can be used with a variety of document formats. For example, an input stream can provide content in any format so `InputStreamHandle` can be used for any document format. Where the manager does not specify the format, you can call `setFormat()` on the handle. For example, you can call the following to write a JSON document with `GenericDocumentManager` or read search results as JSON with `QueryManager`.:

```
InputStreamHandle.setFormat(Format.JSON);
```

For handles intended for reading and writing content and metadata, the following table shows which content types can be used with a given handle type, and what operations are supported (reading, writing, or both). If no letter is present, the handle cannot do anything with that format. If you use a handle on a format it does not accept, it throws an exception.

| Handle Name | XML | Text | JSON | Binary |
|---|---|---|---|---|
| `BytesHandle` | RW | RW | RW | RW |
| `DocumentMetadataHandle` | RW | | | |
| `DOMHandle` | RW | | | |
| `DOM4JHandle` | RW | | | |
| `FileHandle` | RW | RW | RW | RW |
| `GSONHandle` | | | RW | |
| `InputSourceHandle` | RW | | | |
| `InputStreamHandle` | RW | RW | RW | RW |
| `JacksonHandle` | | | RW | |
| `JAXBHandle` | RW | | | |
| `JDOMHandle` | RW | | | |
| `OutputStreamHandle` | W | W | W | W |
| `ReaderHandle` | RW | RW | RW | |
| `SourceHandle` | RW | | | |
| `StringHandle` | RW | RW | RW | |
| `XMLEventReaderHandle` | RW | | | |
| `XMLStreamReaderHandle` | RW | | | |
| `XOMHandle` | RW | | | |

For example, consider a binary JPEG file. To write it to the database, you can use any of these handle types: `BytesHandle, FileHandle, InputStreamHandle, OutputStreamHandle.`

To read an XML document from the server into a DOM document object in Java memory, do the following:

```
XMLDocumentManager docMgr = client.newXMLDocumentManager();
DOMHandle handle = new DOMHandle();
docMgr.read(docId, handle); //docId is the document's URI
org.w3c.dom.Document document = handle.get();
```

To write content to a database document, set a handle to contain the content, then pass that handle to a document manager's `write()` method. For example:

```
XMLDocumentManager docMgr = client.newXMLDocumentManager();
DOMHandle handle = new DOMHandle();
handle.set(document);
docMgr.write(docId, handle);
```

## 1.8 Thread Safety of the Java API

You should be aware of the following API characteristics with respect to thread safety:

- `DatabaseClient` is thread safe after initialization.
- The various manager classes are thread safe after initial configuration. Examples: `DocumentManager`, `QueryManager`, `ResourceManager`.
- Handles are not thread safe. Examples: `StringHandle`, `FileHandle`, `SearchHandle`.
- Builders are not thread safe. Examples: `DocumentPatchBuilder`, `StructuredQueryBuilder`.

For example, you can create a `DocumentManager` for manipulating XML documents and share it across multiple threads. Similarly, you can create a `QueryManager`, set the page length, and then share it between multiple threads.

Handles can be used across multiple requests within the same thread, but cannot be used across threads, so whenever you create a new thread, you must create new Handle objects to use in that thread.

# 2.0 Document Operations

This chapter describes how to create, delete, write to, and read document content and metadata using the Java API. It describes core methods such as `read()`, `write()`, `delete()`, and so on. These methods have many different signatures for use with more advanced operations such as transactions, transforms, and others. Specific method signatures for calling `read()`, etc. in these advanced contexts are discussed when a relevant operation is covered.

When working with documents, it is important to keep in mind the difference between a document on your client and a document in the database. In particular, any changes you make to a document's content and metadata on the client do not persist between sessions. Only if you write the document out to the database do your changes persist.

This chapter includes the following sections:


- Document Creation
- Document Deletion
- Reading Document Content
- Writing A Binary Document
- Reading Content From A Binary Document
- Reading, Modifying, and Writing Metadata
- Conversion of Document Encoding
- Partially Updating Document Content and Metadata


## 2.1 Document Creation

Document creation is not done via a document creation method. When you first write content via a Manager object to a document in the database as identified by its URI, MarkLogic Server creates a document in the database with that URI and content.

> **Note:** To call `write()`, an application must authenticate as a user with at least one of the `rest-writer` or `rest-admin` roles (or as a user with the `admin` role).

This section describes the following about document creation operations:


- Writing an XML Document To The Database
- Creating a Text Document In the Database
- Automatically Generating Document URIs

### 2.1.1 Writing an XML Document To The Database

Note that no changes you make to a document or its metadata persist until you write the document out to the database. Within your application, you are only manipulating it within system memory, and those changes will vanish when the application ends. The database content is constant until and unless a write or delete operation changes it.

The basic steps needed to write a document are:

1. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

   ```
   DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
   ```

2. If you have not already done so, use the `DatabaseClient` object to create a `com.marklogic.client.document.DocumentManager` object of the appropriate subclass for the document content you want to access (XML, text, JSON, binary, generic). In this example code, an `XMLDocumentManager`.

   ```
   XMLDocumentManager docMgr = client.newXMLDocumentManager();
   ```

3. Get the document's content. For example, by using an `InputStream`.

   ```
   FileInputStream docStream = new FileInputStream(
                                    "data"+File.separator+filename);
   ```

4. Create a handle associated with the input stream to receive the document's content. How you get content determines which handle you use. Use the handle's `set()` method to associate it with the desired stream.

   ```
   InputStreamHandle handle = new InputStreamHandle(docStream);
   ```

5. Write the document's content by calling a `write()` method on the `DocumentManager`, with arguments of the document's URI and the handle.

   ```
   docMgr.write(docId, handle);
   ```

6. When finished with the database, release the connection resources by calling the `DatabaseClient` object's `release()` method.

   ```
   client.release();
   ```

### 2.1.2 Creating a Text Document In the Database

This procedure outlines a very basic creation operation for a simple text document is as follows:

1. Create a `com.marklogic.client.DatabaseClient` for the database.

```
DatabaseClient client = DatabaseClientFactory.newClient(
    host, port, user, password, authType);
```

2. Create a `com.marklogic.client.document.DocumentManager` object of the appropriate format for your document; text, binary, JSON, XML, or generic if you are not sure.

```
TextDocumentManager docMgr = client.newTextDocumentManager();
```

3. For convenience's sake, set a variable to your new document's URI. This is not required; the raw string could be used wherever `docId` is used.

```
String docId = "/example/text.txt";
```

4. As discussed previously in "Handles" on page 13, within MarkLogic Java applications you use handle objects to contain a document's content and metadata. Since this is a text document, we will use a `com.marklogic.client.io.StringHandle` to contain the text content. After creation, set the handle's value to the document's initial content.

```
StringHandle handle = new StringHandle();
handle.set("A simple text document");
```

5. Write the document content out to the database. This creates the document in the database if it is not already there (if it is already there, it updates the content to whatever is in the `handle` argument). The identifier for the document is the value of the `docId` argument.

```
docMgr.write(docId, handle);
```

6. When finished with the database, release the connection resources by calling the `DatabaseClient` object's `release()` method.

```
client.release();
```

### 2.1.3 Automatically Generating Document URIs

MarkLogic Server can automatically generate database URIs for documents inserted using the Java API. You can only use this feature to create new documents. To update an existing document, you must know the URI.

To insert a document with a generated URI, use a `com.marklogic.client.document.DocumentUriTemplate` with `DocumentManager.create()`, as described by the following procedure.

1. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

```
DatabaseClient client = DatabaseClientFactory.newClient(
  host, port, user, password, authType);
```

2. If you have not already done so, use the `DatabaseClient` object to create a `com.marklogic.client.document.DocumentManager` object of the appropriate subclass for the document content you want to access (XML, text, JSON, binary, generic). In this example code, an `XMLDocumentManager`.

```
XMLDocumentManager docMgr = client.newXMLDocumentManager();
```

3. Create a `DocumentUriTemplate` using the document manager. Specify the extension suffix for the URIs created with this template. Do not include a "." separator. The following example creates a template that generates URIs ending with `".xml"`.

```
DocumentUriTemplate template = docMgr.newDocumentUriTemplate("xml");
```

4. Optionally, specify additional URI template attributes, such as a database directory prefix and document format. The following example specifies a directory prefix of "/my/docs/".

```
template.setDirectory("/my/docs/");
```

5. Get the document's content. For example, by using an `InputStream`.

```
FileInputStream docStream =
    new FileInputStream("data" + File.separator + filename);
```

6. Create a handle associated with the input stream to receive the document's content. How you get content determines which handle you use. Use the handle's `set()` method to associate it with the desired stream.

```
InputStreamHandle handle = new InputStreamHandle(docStream);
```

7. Insert the document into the database by calling a `create()` method on the `DocumentManager`, passing in a URI template and the handle. Use the returned `DocumentDescriptor` to obtain the generated URI.

```
DocumentDescriptor desc = docMgr.create(template, handle);
```

8. When finished with the database, release the connection resources by calling the `DatabaseClient` object's `release()` method.

```
client.release();
```

## 2.2 Document Deletion

To delete a document, call the `com.marklogic.client.document.DocumentManager` object's `delete()` method with an argument of the URI of the document you want to delete.

> **Note:** To call `delete()`, an application must authenticate as a user with at least one of the `rest-writer` or `rest-admin` roles (or as a user with the `admin` role).

The following example shows how to delete an XML document from the database.

1. Create a `com.marklogic.client.DatabaseClient` for connecting to the database.

```
DatabaseClient client = DatabaseClientFactory.newClient(
   host, port, user, password, authType);
```

2. If you have not already done so, use the `DatabaseClient` object to create a `com.marklogic.client.document.DocumentManager` object of the appropriate subclass for the document format (XML, text, JSON, or binary).

```
XMLDocumentManager docMgr = client.newXMLDocumentManager();
```

3. Delete the document.

```
String docId = "/example/text.xml";
docMgr.delete(docId);
```

4. When finished with the database, release the connection resources by calling the `DatabaseClient` object's `release()` method.

```
client.release();
```

## 2.3 Reading Document Content

Reading requires a handle to access document content.

Note that no changes you make to a document or its metadata persist until you write the document out to the database. Within your application, you are only manipulating it on the client, and those changes will vanish when the application ends. The database content is persistent until and unless a write or delete operation changes it.

If you read content with a stream, you must close the stream when done. If you do not close the stream, HTTP clients do not know that you are finished and there are fewer connections available in the connection pool.

The basic steps to read a document from the database are:

1. Create a `com.marklogic.client.DatabaseClient` for connecting to the database.

```
DatabaseClient client = DatabaseClientFactory.newClient(
   host, port, user, password, authType);
```

2. If you have not already done so, use the `DatabaseClient` object to create a `com.marklogic.client.document.DocumentManager` object of the appropriate subclass for the document format (XML, text, JSON, or binary).

```
XMLDocumentManager docMgr = client.newXMLDocumentManager();
```

3. Create a handle to receive the document's content. For information on handles and the wide variety of handle types, see "Handles" on page 13. This example uses a `com.marklogic.client.io.DOMhandle` object.

```
DOMHandle handle = new DOMHandle();
```

4. Read the document's content by calling a `read()` method on the `DocumentManager`, with arguments of the document's URI and the handle. Here, assume `docId` contains the document's URI.

```
docMgr.read(docId, handle);
```

5. Access the content by calling a `get()` method on the handle. For example, `DomHandle.get` returns a W3C `Document` object. There are many alternatives.

```
Document document = handle.get();
```

6. When finished with the database, release the connection resources by calling the `DatabaseClient` object's `release()` method.

```
client.release();
```

## 2.4 Format-Specific Operations

Different document formats have different things you can do. The following table highlights some of the format-specific operations you can perform on documents:

| Format | Operation |
|---|---|
| binary | On write, you can extract metadata.<br><br>On read, you can extract a range of bytes, only reading that range (instead of the whole document). |
| XML | You can to document repair. |
| JSON | You can specify language. |

## 2.5 Writing A Binary Document

To insert or update a binary document, use a handle containing your binary content with `com.marklogic.client.document.BinaryDocumentManager`. You can use any handle that implements `BinaryWriteHandle`, such as `BytesHandle` or `FileHandle`.

No metadata extraction is performed by default. You can request metadata extraction and specify how it is saved by calling `BinaryDocumentManager.setMetadataExtraction()`.

The following example reads a JPEG image from a file named `my.png` and inserts it into the database as a binary document with URI `/images/my.png`. During insertion, metadata is extracted from the binary content and saved as document properties.

```
String docId = "/example/my.png";
String mimetype = "image/png";

BinaryDocumentManager docMgr = client.newBinaryDocumentManager();
docMgr.setMetadataExtraction(MetadataExtraction.PROPERTIES);

docMgr.write(
    docId,
    new FileHandle().with(new File("my.png")).withMimetype(mimetype)
  );
```

## 2.6 Reading Content From A Binary Document

There are several ways to read content from a binary document.

To stream binary content, use InputStream as follows:

```
InputStream byteStream =
    docMgr.read(docID, new InputStreamHandle()).get();
```

To buffer the binary content, use `com.marklogic.client.io.BytesHandle` object as follows:

```
byte[] buf = docMgr.read(docID, new BytesHandle()).get();
```

Or you can read only part of the content:

```
BytesHandle handle = new BytesHandle();
buf = docMgr.read(docId, handle, 9, 10).get();
```

## 2.7 Reading, Modifying, and Writing Metadata

Reading and writing document metadata from and to the database are very similar operations to reading and writing document content. Each requires calling methods on `com.marklogic.client.document.DocumentManager`. The handle for metadata can be a `DocumentMetadataHandle` to modify metadata in a POJO, or it can be raw XML or JSON.

You can perform operations on the metadata associated with documents such as collections, permissions, properties, and quality. This section describes those metadata operations and includes the following parts:


- Document Metadata
- Reading Document Metadata
- Collections Metadata
- Properties Metadata
- Quality Metadata
- Permissions Metadata
- Manipulating Document Metadata In Your Application
- Writing Metadata


### 2.7.1 Document Metadata

The following are the metadata types in the Java API:

- `COLLECTIONS`: Document collections, a non-hierarchical way of organizing documents in the database. For details, see “Collections Metadata” on page 24
- `PERMISSIONS`: Document permissions. For details, see “Permissions Metadata” on page 26.
- `PROPERTIES`: Document properties. Property-value pairs associated with the document. For details, see “Properties Metadata” on page 25.
- `QUALITY`: Document search quality. Helps determine which documents are of the best quality. For details, see “Quality Metadata” on page 26.

The enum `DocumentManager.Metadata` enumerates the metadata categories (including `ALL`). They are described in detail later in this chapter.

### 2.7.2 Reading Document Metadata

The basic steps needed to read a document’s metadata are:

1. Create a `com.marklogic.client.DatabaseClient` for connecting to the database.

```
DatabaseClient client = DatabaseClientFactory.newClient(
   host, port, user, password, authType);
```

2. If you have not already done so, use the `DatabaseClient` object to create a `com.marklogic.client.document.DocumentManager` object of the appropriate subclass for the document format (XML, text, JSON, or binary).

```
XMLDocumentManager docMgr = client.newXMLDocumentManager();
```

3. Create a `com.marklogic.client.io.DocumentMetadataHandle` object, which will receive the document's metadata. Alternately, you can create raw XML or JSON.

```
DocumentMetadataHandle metadataHandle = new DocumentMetadataHandle();
```

4. If you also want to get the document's content, create a handle to receive it. Note that you need separate handles for a document's content and metadata.

```
DOMHandle docHandle = new DOMHandle();
```

5. Read the document's metadata by calling a `readMetadata()` method on the `DocumentManager`, with an argument of the metadata handle. Note that you can also call `read()` with an additional argument of a content handle so that it will read the metadata into the metadata handle and the content into the content handle in a single operation. To call `read()`, an application must authenticate as `rest-reader`, `rest-writer`, or `rest-admin`. Below, `docId` is a variable containing a document URI.

```
//read only the metadata into a handle
docMgr.readMetadata(docId, metadataHandle);
//read metadata and content
docMgr.read(docId, metadataHandle, docHandle);
```

6. Access the metadata by calling `get()` methods on the metadata handle. Later sections in this chapter show how to access the other types of metadata.

```
DocumentCollections collections = metadataHandle.getCollections();
Document document = contentHandle.get();
```

7. When finished with the database, release the connection resources by calling the `DatabaseClient` object's `release()` method.

```
client.release();
```

By default, `DocumentManager` reads and writes all categories of metadata. To read or write a subset of the metadata categories, configure `DocumentManager` by calling `setMetadataCategories()`.

### 2.7.3 Collections Metadata

Collections are a way to organize documents in a database. A collection defines a set of documents in the database. You can set documents to be in any number of collections either at the time the document is created or by updating a document. Searches against collections are both efficient and convenient. For more details on collections, see Collections in the *Search Developer's Guide*.

The Java API allows you to read and manipulate collections metadata using the `com.marklogic.client.io.DocumentMetadataHandle.DocumentCollections`. Collections are named by specifying a URI. A collection URI serves as an identifier, and it can be any valid URI.

The code in this section assumes a `DocumentManager` object of an appropriate type for the document, `docMgr`, and a string containing a document URI, `docId`, have been created.

To get all collections for a document and put them in an array, do the following:

```
//Get the set of collections the document belongs to and put in array.
DocumentCollections collections = metadataHandle.getCollections();
```

To check if a collection URI exists in a document's set of collections, do the following:

```
collections.contains("/collection_name/collection_name2");
```

To add a document to one or more collections, do the following:

```
collections.addAll("/shakespeare/sonnets", "/shakespeare/plays");
```

To remove a document from a collection, do the following:

```
collections.remove("/shakespeare/sonnets");
```

To remove a document from all its collections, do the following:

```
collections.clear();
```

### 2.7.4 Properties Metadata

Manipulate properties metadata using the `com.marklogic.client.io.DocumentMetadataHandle.DocumentProperties` class.

The code in this section assumes a `DocumentManager` object, `docMgr`, and a string containing a document's URI, `docId`, have been created.

To get all of a document's properties metadata, do the following:

```
DocumentProperties properties = metadataHandle.getProperties();
```

`DocumentProperties` objects represent a document's properties as a map.

To check if a document's properties contain a specific property name, do the following:

```
exists = properties.containsKey("name");
```

To get a specific property's value do the following:

```
value = metadataHandle.getProperties("name");
```

You can add any new property names and values to a document that you want. To add a new property or change the value of an existing property in a document's metadata do the following:

```
metadataHandle.getProperties().put("name", "value");
```

### 2.7.5 Quality Metadata

The code in this section assumes a `com.marklogic.client.io.DocumentManager` object, `docMgr`, and a string containing a document's URI, `docId`, have been created.

The quality metadata affects the ranking of documents for use in searches my creating a multiplier for calculating the score for that document, and the default value for quality in the Java API is `0`.

To get a document's search quality metadata value do the following:

```
int quality = metadataHandle.getQuality();
```

To set a document's search quality value do the following:

```
metadataHandle.setQuality(3);
```

### 2.7.6 Permissions Metadata

Permissions on documents control who can access a document for the capabilities of read, update, insert, and execute. To perform one of these operations on a document, a user must have a role corresponding to the permission for each capability needed. For details on permissions and on the security model in MarkLogic Server, see the *Understanding and Using Security Guide*.

The code in this section assumes a `DocumentManager` object, `docMgr`, and a string containing a document's URI, `docId`, have been created. Manipulate document properties using the class `com.marklogic.client.io.DocumentMetadataHandle.DocumentPermissions`.

MarkLogic Server defines permissions using roles and capabilities.

The allowed values for capabilities are those in the enum `com.marklogic.client.io.DocumentMetadataHandle.Capability`:

- `EXECUTE` - Permission to execute the document.
- `INSERT` - Permission to create but not modify or delete the document.
- `READ` - Permission to read the document but not modify it..
- `UPDATE` - Permission to create, modify, or delete the document, but not to read it.

Roles are assigned to users via the Admin Interface or through other administrative tools, and cannot be assigned via the Java API. You can, however, control permissions on documents as part of their metadata.

To get permissions metadata for a document, do the following:

```
DocumentPermissions permissions = metadataHandle.getPermissions()

metadataHandle.getPermissions().add("app-user",
   Capability.UPDATE, Capability.READ);
```

### 2.7.7 Manipulating Document Metadata In Your Application

A `DocumentMetadataHandle` represents metadata as a POJO. A `DocumentMetadataHandle` has several methods for manipulating a document's metadata. That may not be how you want to work with the metadata, however. If you would prefer to work with it as XML, then read it with an XML handle. If you would prefer to work with it as JSON, read it with a JSON handle. A `StringHandle` can use either XML or JSON, defaulting to XML.

To specify the format for reading content, use `setFormat()`, as in the following example:

```
StringHandle metadataHandle = new StringHandle();
metadataHandle.setFormat(Format.JSON);
```

### 2.7.8 Writing Metadata

When you are finished modifying metadata categories, you must write it to the database to persist it. Note that the above operations all only change the document's metadata stored on the client, and do not change the metadata for document in the database. To write the metadata changes to the database, as well as the document content, do the following:

```
InputStreamHandle handle = new InputStreamHandle(docStream);
docMgr.write(docId, metadataHandle, handle);
```

## 2.8 Conversion of Document Encoding

The Java API handles encoding conversions for you, but you have to:

- know the encoding
- use the appropriate handle

If you specify the encoding and it turns out to be the wrong encoding, then the conversion will likely not turn out as you expect.

MarkLogic Server stores text, XML, and JSON as UTF-8. In Java, characters in memory and reading streams are UTF-16. The Java API converts characters to and from UTF-8 automatically.

When writing documents to the server, you need to know if they are already UTF-8 encoded. If a document is not UTF-8, you must specify its encoding or you are likely to end up with data that has incorrect characters due to the incorrect encoding. If you specify a non-UTF-8 encoding, the Java API will automatically convert the encoding to UTF-8 when writing to MarkLogic.

When writing characters to or reading characters from a file, Java defaults to the platform's standard encoding. For example, there is different platform encoding on Linux than Windows.

XML supports multiple encodings as defined by the header (called an XML declaration):

```
<?xml version="1.0" encoding ="utf-8">
```

The XML declaration declares a file's encoding. XML parsing tools, including handles, can determing encoding from this and do the conversion for you.

When writing character data to the database, you need to pick an appropriate handle type, depending on your intent and circumstances.

Depending on your application, you may need to be aware that MarkLogic Server normalizes text to precomposed Unicode characters for efficiency. Unicode abstract characters can either be precomposed (one character) or decomposed (two characters). If you write a decomposed Unicode document to MarkLogic Server and then read it back, you will get back precomposed Unicode. Usually, you do not need to care if characters are precomposed or decomposed. This Unicode issue only affects some characters, and many APIs abstract away the difference. For instance, the Java collator treats the precomposed and decomposed forms of a character as the same character. If your application needs to compensate for this difference, you can use `java.text.Normalizer`; for details, see:

http://docs.oracle.com/javase/6/docs/api/java/text/Normalizer.html

The following table describes possible cases for reading character data with recommended handles to use in each case.

| Read Condition | Recommended Handle(s) |
|---|---|
| If reading binary data: | Use `BytesHandle`, `FileHandle`, or `InputStreamHandle`. |
| If reading character data from the database: | `BytesHandle`, `FileHandle`, `InputStreamHandle`, and the XML handles are encoded as UTF-8. `StringHandle` and `ReaderHandle` convert to UTF-16. |

The following table describes possible cases for writing character data with recommended handles to use in each case.

| Write Condition | Recommended Handle(s) |
|---|---|
| If the data you are writing is a Java string: | Use `StringHandle`; it converts on write from UTF-16 to UTF-8. |
| If writing binary data: | Use `BytesHandle`, `FileHandle`, or `InputStreamHandle`. |
| If the data you are writing is encoded as UTF-8 and you do not need to modify the data: | Use `BytesHandle`, `FileHandle`, or `InputStreamHandle`. |
| If it is XML that declares an encoding other than UTF-8 in the XML declaration and you do not need to modify the data: | Use `InputSourceHandle`, `XMLEventReaderHandle`, or `XMLStreamReaderHandle`; these convert to UTF-8. |
| If the character data to write is XML that declares the encoding in a prolog and you need to modify the data: | Use `DOMHandle`, `SourceHandle`, or create a handle class on an open source DOM. For examples of the latter, see `JDOMHandle`, `XOMHandle`, or `DOM4JHandle` in the package `com.marklogic.client.extra`. All these classes convert to UTF-8. |
| If the character data to write has a known encoding other than UTF-8 and you don't need to modify the data: | Use `ReaderHandle` and specify the encoding when creating the `Reader` (as usual in Java); these convert to UTF-8. |

| Write Condition | Recommended Handle(s) |
|---|---|
| If the character data to write is XML with a known but undeclared encoding and you need to modify the data: | Use `DOMHandle` with a `DocumentBuilder` parsing an `InputSource` with a specified encoding as in:<br><br>`DOMHandle handle = new DOMHandle();`<br>`handle.set(`<br>`handle.getFactory().newDocumentBuilder()`<br>`parse(newInputSource(...reader specifying charset ...)));`<br><br>or Use `SourceHandle` with a `StreamReader` on a `Reader` with a specified encoding as in:<br><br>`SourceHandle handle = new SourceHandle();`<br>`handle.set(new StreamSource(... reader specifying charset ...));` |
| If the character data to write is JSON and you need to modify the data: | Consider using a JSON library such as Jackson or GSON. See `com.marklogic.client.extra.JacksonHandle` for an example. |
| If the character data to write is text other than JSON or XML and you need to modify the data: | Consider using a `StreamTokenizer` with a `Reader`, or `Pattern` with a `String` |

## 2.9 Partially Updating Document Content and Metadata

The interface `com.marklogic.client.document.DocumentPatchBuilder` enables you to update a portion of an existing document or its metadata. This section covers the following topics:

- Introduction to Content and Metadata Patching
- Basic Steps for Patching Documents and Metadata
- Defining the Context for a Patch Operation
- Managing XML Namespaces in a Patch
- Construct a Patch From Raw XML or JSON
- Construct Replacement Data on the Server

### 2.9.1 Introduction to Content and Metadata Patching

A *partial update* is an update you apply to a portion of a document or metadata, rather than replacing an entire document or all of the metadata. For example, inserting an XML element or attribute or changing the value associated with a JSON key. You can only apply partial content updates to XML and JSON documents. You can apply partial metadata updates to any document type.

Use a partial update to do the following operations:

- Add, replace, or delete an XML element, XML attribute, or JSON sub-object of an existing document.
- Add, replace, or delete a subset of the metadata of an existing document. For example, modify a permission or insert a property.
- Dynamically generate replacement content or metadata on MarkLogic Server using builtin or user-defined functions. For details, see “Construct Replacement Data on the Server” on page 37.

You can apply multiple updates in a single patch, and you can update both content and metadata in the same patch.

A *patch* is a partial update descriptor, expressed in XML or JSON, that tells MarkLogic Server where to apply an update and what update to apply. Four operations are available in a patch: insert, replace, replace-insert, and delete. (A replace-insert operation functions as a replace, as long as at least one match exists for the target content; if there are no matches, then the operation functions as an insert.)

Patch operations can target XML elements and attributes, JSON key-value pairs, and data values. You identify the target of an operation using XPath and JSONPath expressions. When inserting new content or metadata, the insertion point is further defined by specifying the position; for details, see How Position Affects the Insertion Point in the *REST Application Developer’s Guide*.

When applying a patch to document content, the patch format must match the document format: An XML patch for an XML document, a JSON patch for a JSON document. You cannot patch the content of other document types. You can patch metadata for all document types. A metadata-only patch can be in either XML or JSON. A patch that modifies both content and metadata must match the document content type.

You can construct a patch from raw JSON or XML, or using one of the following builder interfaces:

- `com.marklogic.client.document.DocumentPatchBuilder`
- `com.marklogic.client.document.DocumentMetadataPatchBuilder`

Apply a patch by passing a handle to it to the `patch()` method of a `DocumentManager`. The following example sketches construction of a patch using a builder, and then applying the patch to an XML document. The patch inserts a `<child/>` element as the last child element of the node addressed by the XPath expression `/data`.

```
DocumentPatchBuilder xmlPatchBldr = xmlDocMgr.newPatchBuilder();
DocumentPatchHandle xmlPatch =
    xmlPatchBldr.insertFragment(
        "/data",
        Position.LAST_CHILD,
        "<child>the last one</child>")
      .build();
xmlDocMgr.patch(docId, xmlPatch);
```

For detailed instructions, see “Basic Steps for Patching Documents and Metadata” on page 32.

If a patch contains multiple operations, they are applied independently to the target document. That is, within the same patch, one operation does not affect the context path or select path results or the content changes of another. Each operation in a patch is applied independently to every matched node. If any operation in a patch fails with an error, the entire patch fails.

Content transformations are not directly supported in a partial update. However, you can implement a custom replacement content generation function to achieve the same effect. For details, see “Construct Replacement Data on the Server” on page 37.

### 2.9.2 Basic Steps for Patching Documents and Metadata

Follow this procedure to use a builder to create and apply a patch to the contents of an XML or JSON document, or to the metadata of any type of document. To construct a patch without using a builder, see “Construct a Patch From Raw XML or JSON” on page 33.

You can combine content and metadata updates in the same patch. When you do so, the patch format must match the content type of the documents. When you construct a patch that only modifies metadata, you can use either XML or JSON as the format.

1. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

   ```
   DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
   ```

2. If you have not already done so, use the `DatabaseClient` object to create a `com.marklogic.client.document.DocumentManager` object of the appropriate subclass for the document content you want to access (XML, JSON, binary, or text). In this example code, an `XMLDocumentManager`.

   ```
   XMLDocumentManager docMgr = client.newXMLDocumentManager();
   ```

**Note:** You can only apply content patches to XML and JSON documents.

3. Create a `com.marklogic.client.document.DocumentPatchBuilder` using the document manager. If you are patching content, you must specify a `Format` corresponding to the target document type, either XML or JSON. For example:

```
DocumentPatchBuilder builder = docMgr.newPatchBuilder(Format.XML);
```

4. Call the patch builder methods to define insert, replace, replace-insert, and delete operations for the patch. The following example adds an element insertion operation:

```
builder.insertFragment("/data", Position.LAST_CHILD,
    "<child>the last one</child>");
```

For details on identify the target content for an operation, see “Defining the Context for a Patch Operation” on page 35.

5. Create a handle associated with the patch using `DocumentPatchBuilder.build()`. For example:

```
DocumentPatchHandle handle = builder.build();
```

**Note:** Once you call `build()`, the patch contents are fixed. Subsequent calls to define additional operation, such as calling `insertFragment` again, will have no effect.

6. Apply the patch by calling a `patch()` method on the `DocumentManager`, with arguments of the document’s URI and the handle.

```
docMgr.patch(docId, handle);
```

7. When finished with the database, release the connection resources by calling the `DatabaseClient` object’s `release()` method.

```
client.release();
```

### 2.9.3 Construct a Patch From Raw XML or JSON

This section describes how to create and apply a patch that you construct directly using XML or JSON. To construct a patch using a Java builder, see “Basic Steps for Patching Documents and Metadata” on page 32.

When you construct a patch that modifies both content and metadata, the patch format must match the content type of the target XML or JSON document. When you construct a patch that only modifies metadata, the patch format can use either XML or JSON, and the patch can be applied to the metadata of any type of document (XML, JSON, text, or binary).

For examples of raw patches, see XML Examples of Partial Updates or JSON Examples of Partial Update in the *REST Application Developer’s Guide*:

Follow this procedure to create and apply a raw XML or JSON patch to the contents of an XML or JSON document, or to the metadata of any type of document.

1. Create a JSON or XML representation of the patch operations, using the tools or library of your choice. For syntax, see XML Patch Reference and JSON Patch Reference and in the *REST Application Developer's Guide*. The following example uses a `String` representation of a patch that inserts an element in an XML document:

```
String xmlPatch =
    "<rapi:patch xmlns:rapi='http://marklogic.com/rest-api'>" +
      "<rapi:insert context='/data' position='last-child'>" +
        "<child>the last one</child>" +
      "</rapi:insert>" +
    "</rapi:patch>";
```

2. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

```
DatabaseClient client = DatabaseClientFactory.newClient(
  host, port, user, password, authType);
```

3. If you have not already done so, use the `DatabaseClient` object to create a `com.marklogic.client.document.DocumentManager` object of the appropriate subclass for the document content you want to access (XML, JSON, binary, or text). In this example code, an `XMLDocumentManager`.

```
XMLDocumentManager docMgr = client.newXMLDocumentManager();
```

   **Note:** You can only apply content patches to XML and JSON documents.

4. If you represented your patch as XML, create a handle that implements `DocumentPatchHandle` and associate your patch with the handle. For example:

```
DocumentPatchHandle handle = new StringHandle(xmlPatch);
```

5. If you represented your patch as JSON, create a handle that implements `DocumentPatchHandle`, set the handle content format to JSON, and associate your patch with the handle. For example:

```
DocumentPatchHandle handle = new StringHandle();
handle.withFormat(Format.JSON).set(jsonPatch);
```

6. Apply the patch by calling a `patch()` method on the `DocumentManager`, with arguments of the document's URI and the handle.

```
docMgr.patch(docId, handle);
```

7. When finished with the database, release the connection resources by calling the `DatabaseClient` object's `release()` method.

```
client.release();
```

### 2.9.4 Defining the Context for a Patch Operation

When you insert, replace, or delete content or metadata, the patch definition must include enough context to tell MarkLogic Server what XML or JSON components to operate on. For example, which element or key-value pair to delete, where to insert a new element or object, or which element, object, or value to replace.

When you create a patch using a builder, you specify the context through the contextPath and selectPath parameters of builder methods such as `DocumentPatchBuilder.insertFragment()` or `DocumentPatchBuilder.replaceValue()`. When you create a patch from raw XML or JSON, you specify the operation context through the `context` and `select` XML attributes or JSON keys.

For XML documents, you specify the context using an XPath (XML) expression.The XPath you can use is limited to the subset that can be used to define a path range index. For details, see Path Expressions Usable in Index Definitions in the *REST Application Developer's Guide*.

For JSON documents, use JSONPath (JSON). The JSONPath you can use has the same limitation as those that apply to XPath. For details, see Introduction to JSONPath and Path Expressions Usable in Index Definitions in the *REST Application Developer's Guide*.

### 2.9.5 Managing XML Namespaces in a Patch

Namespaces potentially impact two parts of a patch operation:

- The XPath expression(s) that define the context for an operation, such as which nodes to replace or where to insert new content.
- New or replacement content.

Your patch must include definitions of any namespaces used in these contexts. The way you do so varies, depending on whether or not you use a builder to construct your patch. This section covers the following topics:

- Defining Namespaces With a Builder
- Defining Namespaces in Raw XML

#### 2.9.5.1 Defining Namespaces With a Builder

When you construct a patch with `DocumentPatchBuilder`, define any namespaces used in XPath context or select expressions by calling `DocumentPatchBuilder.setNamespaces()`. Such namespace definitions are patch-wide. That is, they apply to all operations in the patch.

Namespaces used in insertion or replacement content can either be patch-wide, as with XPath expressions, or defined inline on content elements.

The patch generated by the builder pre-defines the following namespace aliases for you:

- `xmlns:rapi="http://marklogic.com/rest-api"`
- `xmlns:prop="http://marklogic.com/xdmp/property"`
- `xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"`
- `xmlns:xi="http://www.w3.org/2001/XMLSchema"`

The following example defines three namespace aliases (`r`, `t`, and `n`) and uses them in defining the insertion context and the content to be inserted.

```
import com.marklogic.client.util.EditableNamespaceContext;
...
// construct a list of namespace definitions
EditableNamespaceContext namespaces = new EditableNamespaceContext();
namespaces.put("r", "http://root.org");
namespaces.put("t", "http://target.org");
namespaces.put("n", "http://new.org");

// add the namespace definitions to the patch
DocumentPatchBuilder builder = docMgr.newPatchBuilder();
builder.setNamespaces(namespaces);

// use the namespace aliases when definition operations
String newElem = "<n:new>";
builder.insertFragment(
    "/r:root/t:target", Position.LAST_CHILD, newElem);
```

You can also define the content namespace element `n` inline, as shown in the following example:

```
String newElem = "<n:new xmlns:n=\"http://new.org\">";
```

### 2.9.5.2 Defining Namespaces in Raw XML

When you construct a patch directly in XML, define any namespaces used in XPath context or select expressions on the root `<patch/>` element. Namespace definitions are patch-wide and apply to both XPath expressions and insertion or replacement content.

The `<patch />` element must be defined in the namespace `http://marklogic.com/rest-api`. It is recommended that you use a namespace alias for this namespace so that element and attribute references in your patch that are not namespace qualified do not end up in the `http://marklogic.com/rest-api namespace`.

The following example defines four namespace aliases, one for the patch (`rapi`) and three content-specific aliases (`r`, `n`, and `t`). The content-specific aliases are used in defining the insertion context and the content to be inserted.

```
<rapi:patch xmlns:rapi="http://marklogic.com/rest-api"
    xmlns:r="http://root.org" xmlns:t="http://target.org"
    xmlns n="http://new.org">
  <rapi:insert context="/r:root/t:target" position="last-child">
    <n:new />
```

```
    </rapi:insert>
</rapi:patch>
```

For more details, see Managing XML Namespaces in a Patch in the *REST Application Developer's Guide*.

### 2.9.6 Construct Replacement Data on the Server

This section describes using builtin or user-defined XQuery replacement functions to generate the content for a partial update replace or replace-insert operation dynamically on MarkLogic Server.

The builtin functions support simple arithmetic and string manipulation. For example, you can use a builtin function to increment the current value of numeric data or concatenate strings. For more complex operations, create and install a user-defined function.

To create a user-defined replacement function, see Writing a User-Defined Replacement Constructor in the *REST Application Developer's Guide*. Install your implementation into the modules database associated with your REST Server; for details, see "Managing Dependent Libraries and Other Assets" on page 107.

To apply a builtin or user-defined server-side function to a patch operation when you create a patch with a patch builder, use a `DocumentMetadataPatchBuilder.CallBuilder`, obtained by calling `DocumentMetadataPatchBuilder.call()`. The builtin functions are exposed as methods of `CallBuilder`. The following example adds a replace operation to a patch that multiplies the current data value in `child` elements by 3.

```
DocumentPatchBuilder builder = docMgr.newPatchBuilder();
builder.replaceApply("child", builder.call().multiply(3));
```

To apply the same operation to a raw XML or JSON patch, use the `apply` XML attribute or JSON key of the operation. The following raw patches are equivalent to the patch produced by the above builder example. For details, see Constructing Replacement Data on the Server in the *REST Application Developer's Guide*.

| XML | JSON |
|---|---|
| <rapi:patch<br>xmlns:rapi="http://marklogic.com/rest-api"><br><rapi:replace<br>select="child"<br>**apply="ml.multiply"**>3</rapi:replace><br></rapi:patch> | {"patch": [<br>{"replace": {<br>"select": "child",<br>**"apply": "ml.multiply"**,<br>"content": 3<br>} }<br>] } |

To apply a user-defined replacement function using a patch builder, first associate the module containing the function with the patch by calling `DocumentPatchBuilder.library()`, and then apply the function to an operation using one of the `CallBuilder.applyLibrary*` methods. The following example applies the function `my-func` in the module namespace `http://my/ns`, implemented in the XQuery library module installed in the modules database at `/my.domain/my-lib.xqy`.

```
DocumentPatchBuilder builder = docMgr.newPatchBuilder();

builder.library("http://my/ns", "/my.domain/my-lib.xqy");
builder.replaceApply("child", builder.call().applyLibrary("my-func");
```

When you construct a raw XML or JSON patch, associate the containing library module with the patch using the `replace-library` patch component, then apply the function to a replace or replace-insert operation using the apply XML attribute or JSON key-value pair. The following examples are equivalent to the above builder code. For more details, see Using a Replacement Constructor Function in the *REST Application Developer's Guide*.

| XML | JSON |
|---|---|
| `<rapi:patch`<br>`  xmlns:rapi="http://marklogic.com/rest-api">`<br>`  <rapi:replace-library`<br>`  at="/my.domain/my-lib.xqy"`<br>`  ns="http://my/ns" />`<br>`  <rapi:replace select="child" apply="my-func"/>`<br>`</rapi:patch>` | `{"patch": [`<br>`  {"replace-library": {`<br>`  "at": "/my.domain/my-lib.xqy",`<br>`  "ns": "http://my/ns"`<br>`  } },`<br>`  {"replace": {`<br>`  "select": "child",`<br>`  "apply": "my-func"`<br>`  } }`<br>`] }` |

# 3.0 Searching

This chapter describes how to submit searches using the Java API, and includes the following sections:


- Overview of Search Using the Java API
- Using SearchHandle to Examine Query Results
- Search Using String Query Definition
- Search Documents Using Key-Value Query Definition
- Search Documents Using Structured Query Definition
- Prototype a Query Using Query By Example
- Apply Dynamic Query Options to Document Searches
- Search On Tuples (Tuples Query / Values Query)
- Limiting A Search To Specific Collections And/Or A Directory
- Transforming Search Results
- Generating Search Term Completion Suggestions


## 3.1 Overview of Search Using the Java API

The MarkLogic Java API provides two fundamental ways of querying the database:

- Searches on documents, which return search results, snippets, and facets.
- Value or Tuple (co-occurrences) searches, which return data from range indexes and the results of aggregate functions (including user-defined aggregate functions) from range indexes.

When you search documents you can express search criteria using one of the following kinds of query:

- String query: Use a Google-style query string to search documents and metadata. For details, see “Search Using String Query Definition” on page 41.
- Key-Value query: Use key-value pair queries for ad hoc queries on XML elements, XML attributes, or JSON keys. For details, see “Search Documents Using Key-Value Query Definition” on page 42.
- Structured query: A simple and easy way to construct queries as a Java, XML, or JSON structure, allowing you to manipulate complex queries (such as geospatial polygons) in the Java client. For details, see “Search Documents Using Structured Query Definition” on page 43
- Combined query: Combine a string or structured query with dynamic query options. For details, see “Apply Dynamic Query Options to Document Searches” on page 53.

When you query or aggregate range indexes, you express your search criteria using a values query.

All search methods can also use persistent query options. *Persistent query options* are stored on the REST Server and referenced by name in future queries. Once created and persisted, you can apply query options to multiple searches, or even set to be the default options for all searches. Note that in XQuery, query option configurations are called *options nodes*.

Some search methods support dynamic query options that you specify at search time. A combined query allows you to bundle a string and/or structured query with dynamic query options to further customize a search on a per search basis. You can also specify persistent query options with a combined query search. The search automatically merges the persistent (or default) query options and the dynamic query options together. For details, see "Apply Dynamic Query Options to Document Searches" on page 53.

Query options can be very simple or very complex. If you accept the defaults, for example, there is no need to specify explicit query options. You can also make them as complex as is needed.

For details on how to create and work with query option configurations, see "Query Options" on page 64. For details on individual query options and their values, see Appendix A: JSON Query Options Reference in the *REST Application Developer's Guide* and Appendix B: XML Query Options Reference in the *REST Application Developer's Guide*. For more information on search concepts, see the *Search Developer's Guide*.

In the examples in this chapter, assume a `DatabaseClient` called `client` has already been defined.

## 3.2 Using SearchHandle to Examine Query Results

Usually, you will use a `SearchHandle` object to contain your query results. The exact nature of results varies, depending on both the handle's configuration and what query options and values were used for the search operation.

You can specify snippets to return in various ways. By default, they return as Java objects. But for custom or raw snippets, they are returned as DOM documents by using the `forceDOM` flag.

There are several ways to access different parts of the search result or control search results from a `SearchHandle`.

- The `getMatchResults()` method returns an array of `MatchDocumentSummary` objects of the matched documents, from which you can further extract for each result its match locations, path, metadata, an array of smippets, fitness, confidence measure, and URI. For details, see the `MatchDocumentSummary` entry in Java API JavaDoc.
- `getMetrics()` returns a `SearchMetrics` object containing various timing metrics about the search.

- `getFacetNames()`, `getFacetResult(name)`, `getFacetResults()` return, respectively, a list of returned facet names, the specified named facet result, and an array of facet results for this search.
- `getTotalResults()` returns an estimate of the number of results from the search.
- `setForceDOM(boolean)` sets the force DOM flag, which if `true` causes snippets to always be returned as DOM documents.

See the Java API JavaDoc for SearchHandle for the full interface.

The following is a typical programming technique for accessing search results using a search handle:

```
// iterate over MatchDOcumentSummary array locations, getting
// the snippet text for each location (you would then do something
// with the snippet text)
MatchDocumentSummary[] summaries = results.getMatchResults();
for (MatchDocumentSummary summary : summaries ) {
    MatchLocation[] locations = summary.getMatchLocations();
    for (MatchLocation location : locations) {
        location.getAllSnippetText();
      // do something with the snippet text
    }
}
```

## 3.3 Search Using String Query Definition

The MarkLogic Server Search API lets you do searches on string arguments, including the usual search operators such as AND and OR. For example, you could search on “Batman”, “Batman AND Robin”, “Batman OR Robin”, etc. For details, see Search Grammar in the *Search Developer’s Guide*.

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

   ```
   QueryManager queryMgr = client.newQueryManager();
   ```

2. Instantiate a `StringQueryDefinition` object. Use `StringQueryDefinition.setCriteria()` to specify your search string.

   ```
   StringQueryDefinition qd = queryMgr.newStringDefinition();

   qd.setCriteria("Batman AND Robin");
   ```

3. Run a search with the `StringQueryDefinition` object as an argument, returning a `SearchHandle` object or an XML or JSON handle to get the search results in either of those formats:

   ```
   SearchHandle results = queryMgr.search(qd, new SearchHandle());
   DomHandle results = queryMgr.search(qd, new DomHandle());
   ```

```
StringHandle results = querymgr.search(qd,
    newStringHandle().withFormat(Format.JSON)
```

4. Process and/or display the results using the handle.

## 3.4 Search Documents Using Key-Value Query Definition

A key-value search uses key-value pair queries to search XML and JSON content and metadata using an XML element, an XML attribute, or a JSON key. Using XML elements or attributes may require binding a namespace on the server; for details on namespaces, see “Namespaces” on page 92.

Key-value searches use the `exact` value semantics for the value stored in the database (eqivalent to the `cts:element-value-query` exact option). An exact match uses the query options `"case-sensitive"`, `"diacritic-sensitive"`, `"punctuation-sensitive"`, `"whitespace-sensitive"`, `"unstemmed"`, and `"unwildcarded"`, and by default is performed as an unfiltered search.

This section shows the following ways of doing key-value searches:

- JSON Key-Value Searches
- XML Key-Value Searches

### 3.4.1 JSON Key-Value Searches

The basic steps to query key/value pairs for JSON keys are as follows:

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

2. Instantiate a `KeyValueQueryDefinition` object:

```
KeyValueQueryDefinition kvqdef = queryMgr.newKeyValueDefinition();
```

3. Specify a JSON key/value pair to match JSON documents having that pair.

```
kvqdef.put(queryMgr.newKeyLocator("myKey"), "my value");
```

4. Run a search with the query definition object as an argument, returning a `SearchHandle` object:

```
SearchHandle results = queryMgr.search(kvqdef, new SearchHandle());
```

### 3.4.2 XML Key-Value Searches

The basic steps to query key/value pairs in XML are essentially identical to JSON key-value searches, except for the third step, where instead of using a `KeyLocator` in the query, you use an `ElementLocator`.

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

2. Instantiate a `KeyValueQueryDefinition` object:

```
KeyValueQueryDefinition kvqdef = queryMgr.newKeyValueDefinition();
```

3. Use `KeyValueQueryDefinition.put()` to associate a key-value pair with the query definition as a map. Since this is for a query on XML, it obtains the key value by passing a string of an XML element's name and an XML attribute's name to `newElementLocator()`, which creates and returns an `ElementLocator` used by the `KeyValueQuery`.

```
kvqdef.put(queryMgr.newElementLocator(new QName("myName"), "value");
```

4. Run a search with the query definition object as an argument, returning a handle on the results:

```
SearchHandle results = queryMgr.search(kvqdef, new SearchHandle());
```

The previous example specifies an XML element for the key and matches the value against the exact text content of the element, according to `exact` value semantics and unfiltered search. If you specify an XML attribute for the key, then the key-value search matches the text value of the attribute.

## 3.5 Search Documents Using Structured Query Definition

Structured queries let you construct and modify complex queries in Java, XML, or JSON. For details, see Searching Using Structured Queries in the *Search Developer's Guide*. This section includes the following parts:

- Ways to Create a Structured Query
- Basic Steps to Define a Structured Query Definition
- Creating a Structured Query From Raw XML or JSON
- Structured Query Examples

### 3.5.1 Ways to Create a Structured Query

You can create a structured query in XML, in JSON, or using the `StructuredQueryBuilder` object in the Java API.

To specify a structured query directly in XML or JSON, use `RawStructuredQueryDefinition`; for details, see "Creating a Structured Query From Raw XML or JSON" on page 44. If you construct a structured query directly, it is up to you to make sure the query is constructed correctly. Incorrectly constructed queries can result in syntax errors, a query that does not do what you expect, or other exceptions. For syntax details, see Searching Using Structured Queries in the *Search Developer's Guide*.

The `StructuredQueryBuilder` object in the Java API lets you build out a structured query one piece at a time in Java.

### 3.5.2 Basic Steps to Define a Structured Query Definition

The following are the basic steps needed to define a structured query definition in the Java API. This procedure creates a structured query definition using `StructuredQueryBuilder`. You can also create one directly in XML/JSON; for details, see "Creating a Structured Query From Raw XML or JSON" on page 44.

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

2. Instantiate a `StructuredQueryBuilder`, optionally passing in the name of persistent query options to use with your search.

```
StructuredQueryBuilder qb = new StructuredQueryBuilder(OPTIONS_NAME);
```

3. Use the query builder to create a `StructuredQueryDefinition` object with the desired search criteria.

```
StructuredQueryDefinition querydef =
    qb.and(qb.term("neighborhood"),
           qb.valueConstraint("industry", "Real Estate"));
```

4. Run a search with the `StringQueryDefinition` object as an argument, returning a result handle:

```
SearchHandle results = queryMgr.search(querydef, new SearchHandle());
```

### 3.5.3 Creating a Structured Query From Raw XML or JSON

To create a structured query from a raw XML or JSON representation, use any handle class that implements `com.marklogic.client.io.marker.StructureWriteHandle`.

The Java API includes `StructureWriteHandle` implementations that support creating a structure in XML or JSON from a string (`StringHandle`), a file (`FileHandle`), a stream (`InputStreamHandle`), and popular abstractions (`DOMHandle`, `DOM4JHandle`, `JDOMHandle`). For a complete list of implementations, see the Java API JavaDoc.

Follow this procedure to create a structured query using a handle:

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

2. Create a JSON or XML representation of the query, using a text editor or other tool or library. Use the syntax detailed in Searching Using Structured Queries in the *Search Developer's Guide*. The following example uses `String` for the raw representation:

```
String rawXMLQuery =
    "<search:query "+
          "xmlns:search='http://marklogic.com/appservices/search'>"+
      "<search:term-query>"+
          "<search:text>neighborhoods</search:text>"+
      "</search:term-query>"+
      "<search:value-constraint-query>"+
          "<search:constraint-name>industry</search:constraint-name>"+
          "<search:text>Real Estate</search:text>"+
      "</search:value-constraint-query>"+
    "</search:query>";
```

3. If you express your query in XML, create a handle on your raw query using a class that that implements `StructureWriteHandle`. For example:

```
StringHandle rawHandle = new StringHandle(rawXMLQuery);
```

4. If you express your query in JSON, create a handle using a class that implements `StructureWriteHandle`, set the handle content format to JSON, and associate your query with the handle.

```
StringHandle rawHandle = new StringHandle();
rawHandle.withFormat(Format.JSON).set(rawJSONQuery);
```

5. Create a `RawStructuredQueryDefinition` from the handle. Optionally, include the name of persistent query options. For example:

```
// Use the default persistent query options
RawStructuredQueryDefinition querydef =
    queryMgr.newRawStructuredQueryDefinition(rawHandle);

// Use the persistent options previously saved as "myoptions"
RawStructuredQueryDefinition querydef =
    queryMgr.newRawStructuredQueryDefinition(rawHandle, "myoptions");
```

6. Perform a search using the `RawStructuredQueryDefinition` and a results handle.

```
SearchHandle resultsHandle =
    queryMgr.search(querydef, new SearchHandle());
```

### 3.5.4 Structured Query Examples

This section shows some structured query examples, showing the XML for a structured query and the corresponding Java code using `StructuredQueryBuilder`. You can put each of these examples in context by inserting the `StructuredQueryDefinition` line in the following code:

```
QueryManager queryMgr = dbClient.newQueryManager();
StructuredQueryBuilder sb =
   queryMgr.newStructuredQueryBuilder("myopt");

// put code from examples here
StructuredQueryDefinition criteria =
   ... example of building query definition ...
// end code from examples

StringHandle searchHandle =
  queryMgr.search(
    criteria, new StringHandle()).get();
```

Additionally, these examples use query options from the following code:

```
String options =
    "<search:options " +
        "xmlns:search='http://marklogic.com/appservices/search'>" +
      "<search:constraint name='date'>" +
        "<search:range type='xs:date'>" +
          "<search:element name='date'
ns='http://purl.org/dc/elements/1.1/'/>" +
        "</search:range>" +
      "</search:constraint>" +
      "<search:constraint name='popularity'>" +
        "<search:range type='xs:int'>" +
          "<search:element name='popularity' ns=''/>" +
        "</search:range>" +
      "</search:constraint>" +
      "<search:constraint name='title'>" +
        "<search:word>" +
          "<search:element name='title' ns=''/>" +
        "</search:word>" +
      "</search:constraint>" +
      "<search:return-results>true</search:return-results>" +
      "<search:transform-results apply='raw' />" +
    "</search:options>";

QueryOptionsManager optionsMgr =
  dbClient.newServerConfigManager().newQueryOptionsManager();
optionsMgr.writeOptions("myopt", new StringHandle(options));
```

This section contains the following examples:

- Example: Date Range Structured Query
- Example: Element Index Structured Query

- Example: Property Value Structured Query
- Example: Property Value Structured Query
- Example: Document Structured Query
- Example: Collection Structured Query

### 3.5.4.1 Example: Date Range Structured Query

For the boilerplate code environment in which this example runs, see the code snippet in “Structured Query Examples” on page 46.

The following example defines a query that searches for the `"2005-01-01"` value in the date range index.

```
StructuredQueryDefinition criteria =
   sb.rangeConstraint("date", Operator.EQ, "2005-01-01");

/* XML equivalent
<search:query xmlns:search=
   "http://marklogic.com/appservices/search">
  <search:range-constraint-query>
    <search:constraint-name>date</search:constraint-name>
    <search:value>2005-01-01</search:value>
  </search:range-constraint-query>
</search:query>
*/
```

### 3.5.4.2 Example: Element Index Structured Query

For the boilerplate code environment in which this example runs, see the code snippet in “Structured Query Examples” on page 46.

The following example defines a query that searches for the `"Bush"` value within an element range index on `title`.

```
StructuredQueryDefinition criteria =
   sb.wordConstraint("title", "Bush");

/* XML equivalent
<search:query xmlns:search=
   "http://marklogic.com/appservices/search">
  <search:word-constraint-query>
    <search:constraint-name>title</search:constraint-name>
      <search:text>Bush</search:text>
  </search:word-constraint-query>
</search:query>
*/
```

### 3.5.4.3 Example: Property Value Structured Query

For the boilerplate code environment in which this example runs, see the code snippet in “Structured Query Examples” on page 46.

The following example defines a query that searches for the `"hello"` term in the value of any property.

```
StructuredQueryDefinition criteria =
   sb.properties(sb.term("hello"));

/* XML equivalent
<search:query xmlns:search=
   "http://marklogic.com/appservices/search">
  <search:properties-query>
    <search:term-query>
      <search:text>hello</search:text>
    </search:term-query>
  </search:properties-query>
</search:query>
*/
```

### 3.5.4.4 Example: Property Value Structured Query

For the boilerplate code environment in which this example runs, see the code snippet in “Structured Query Examples” on page 46.

The following example defines a query that searches for documents in the `"http://testdoc/doc6/"` directory.

```
StructuredQueryDefinition criteria =
   sb.directory(true, "http://testdoc/doc6/");

/* XML equivalent
<search:query xmlns:search=
   "http://marklogic.com/appservices/search">
  <search:directory-query>
    <search:uri>
      <search:text>http://testdoc/doc6/</search:text>
    </search:uri>
  </search:directory-query>
</search:query>
*/
```

#### 3.5.4.5 Example: Document Structured Query

For the boilerplate code environment in which this example runs, see the code snippet in "Structured Query Examples" on page 46.

The following example defines a query that searches for the `"http://testdoc/doc6/"` document.

```
StructuredQueryDefinition criteria =
   sb.document("http://testdoc/doc2");

/* XML equivalent
<search:query xmlns:search=
   "http://marklogic.com/appservices/search">
  <search:document-query>
    <search:uri>
      <search:text>http://testdoc/doc2</search:text>
    </search:uri>
  </search:document-query>
</search:query>
*/
```

#### 3.5.4.6 Example: Collection Structured Query

For the boilerplate code environment in which this example runs, see the code snippet in "Structured Query Examples" on page 46.

The following example defines a query that searches documents belonging to the `"http://test.com/set3/set3-1"` collection.

```
StructuredQueryDefinition criteria =
   sb.collection("http://test.com/set3/set3-1");

/* XML equivalent
<search:query xmlns:search=
   "http://marklogic.com/appservices/search">
   <search:collection-query>
    <search:uri>
      <search:text>http://test.com/set3/set3-1</search:text>
      </search:uri>
  </search:collection-query>
</search:query>
*/
```

## 3.6 Prototype a Query Using Query By Example

This section describes how to use the Java API to perform a search using a Query By Example (QBE). A QBE enables rapid prototyping of queries for "documents that look like this" using search criteria that resemble the structure of documents in your database.

This section covers the following topics:

- What is QBE
- Search Documents Using a QBE
- Validate a QBE
- Convert a QBE to a Combined Query

### 3.6.1 What is QBE

A Query By Example (QBE) enables rapid prototyping of queries for "documents that look like this" using search criteria that resemble the structure of documents in your database.

For example, if your documents include an `author` element or key, you can use the following QBE to find documents with an `author` value of "Mark Twain".

| Format | Example |
|---|---|
| XML | `<q:qbe xmlns:q="http://marklogic.com/appservices/querybyexample">`<br>`  <q:query>`<br>`  <author>Mark Twain</author>`<br>`  </q:query>`<br>`</q:qbe>` |
| JSON | `{`<br>`  "$query": { "author": "Mark Twain" }`<br>`}` |

You can only use QBE to search XML and JSON documents. Metadata search is not supported. You can search by element, element attribute, and JSON key; fields are not supported. For details, see Searching Using Query By Example in *Search Developer's Guide*.

A QBE is represented by `com.marklogic.client.query.RawQueryByExampleDefinition` in the Java API. Operations on a QBE are performed through a `QueryManager`.

The Java API supports the following operations on a QBE:

- Search XML and JSON documents.
- Validate the correctness of a QBE.
- Convert a QBE to a combined query for improved performance and full expressiveness.

### 3.6.2 Search Documents Using a QBE

To create a QBE from a raw XML or JSON representation, use any handle class that implements `com.marklogic.client.io.marker.StructureWriteHandle` to create a `RawQueryByExampleDefinition`.

The Java API includes `StructureWriteHandle` implementations that support creating a structure in XML or JSON from a string (`StringHandle`), a file (`FileHandle`), a stream (`InputStreamHandle`), and popular abstractions (`DOMHandle`, `DOM4JHandle`, `JDOMHandle`). For a complete list of implementations, see the Java API JavaDoc.

Follow this procedure to create a QBE and use it in a search:

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

2. Create a JSON or XML representation of the query, using a text editor or other tool or library. Use the syntax detailed in Searching Using Query By Example in the *Search Developer's Guide*. The following example uses `String` for the raw representation:

```
String rawXMLQuery =
  "<q:qbe xmlns:q='http://marklogic.com/appservices/querybyexample'>"+
    "<q:query>" +
      "<author>Mark Twain</author>" +
    "</q:query>" +
  "</q:qbe>";
```

3. If you express your query in XML, create a handle on your raw query using a class that that implements `StructureWriteHandle`. For example:

```
StringHandle rawHandle = new StringHandle(rawXMLQuery);
```

4. If you express your query in JSON, create a handle using a class that implements `StructureWriteHandle`, set the handle content format to JSON, and associate your query with the handle. For example:

```
StringHandle rawHandle = new StringHandle();
rawHandle.withFormat(Format.JSON).set(rawJSONQuery);
```

5. Create a `RawQueryByExampleDefinition` from the handle. Optionally, include the name of persistent query options. For example:

```
// Use the default persistent query options
RawQueryByExampleDefinition querydef =
    queryMgr.newRawQueryByExampleDefinition(rawHandle);
```

```
// Use the persistent options previously saved as "myoptions"
RawQueryByExampleDefinition querydef =
    queryMgr.newRawQueryByExampleDefinition(rawHandle, "myoptions");
```

6. Perform a search using the `RawQueryByExampleDefinition` and a results handle.

```
SearchHandle resultsHandle =
    queryMgr.search(querydef, new SearchHandle());
```

### 3.6.3 Validate a QBE

When you perform a search, MarkLogic Server does not verify the correctnesss of your QBE. If your QBE is syntactically or semantically incorrect, you might get errors or surprising results. To avoid such issues, you can validate your QBE.

To validate a QBE, construct a query as described in "Search Documents Using a QBE" on page 51, and then pass it to `QueryManager.validate()` instead of `QueryManager.search()`. The validation report is returned in a `StructureReadHandle`. For example:

```
StringHandle validationReport =
    queryMgr.validate(qbeDefn, new StringHandle());
```

The report can be in XML or JSON format, depending on the format of the input query and the format you set on the handle. By default, validation returns a JSON report for a JSON input query and an XML report for an XML input query. You can override this behavior using the `withFormat()` method of your response handle.

### 3.6.4 Convert a QBE to a Combined Query

Generating a combined query from a QBE has the following potential benefits:

- Improve search performance.
- Access a wider array of search features.
- Debug your QBE by examining the lower level Search API constructs it generates.

A combined query combines a structured query and query options into a single XML or JSON query. For details, see "Apply Dynamic Query Options to Document Searches" on page 53.

To generate a combined query from a QBE, construct a query as described in "Search Documents Using a QBE" on page 51, and then pass it to `QueryManager.convert()` instead of `QueryManager.search()`. The results are returned in a `StructureReadHandle`. For example:

```
StringHandle combinedQueryHandle =
    queryMgr.convert(qbeDefn, new combinedQueryHandle());
```

The resulting handle can be used to construct a `RawCombinedQueryDefinition`; for details, see "Creating a Combined Query" on page 53.

For more details on the query component of a combined query, see Searching Using Structured Queries in *Search Developer's Guide*.

## 3.7 Apply Dynamic Query Options to Document Searches

You can use a combined query to specify query options on the fly, without first persisting them as named options. A *combined query* is an XML or JSON wrapper around a string query and/or structured query, plus query options.

The following example is a combined query that corresponds to the string query "cat AND dog" plus dynamically setting the `return-query` query option to true. For syntax details, see Syntax in the *REST Application Developer's Guide*.

```
<search xmlns="http://marklogic.com/appservices/search">
  <qtext>cat AND dog</qtext>
  <options>
    <return-query>true</return-query>
  </options>
</search>
```

Combined queries are useful for rapid prototying during development, and for applications that need to modify query options on a per query basis. The `RawCombinedQueryDefinition` class represents a combined query in the Java API.

This section covers the following topics:

- Creating a Combined Query
- Interaction with Persistent Query Options
- Performance Considerations

### 3.7.1 Creating a Combined Query

You can only create a combined query from raw XML or JSON; there is no builder class. Follow the procedure below to bind a handle on the raw representation to a `RawCombinedQueryDefinition` object usable for searching.

To create a combined query, use any handle class that implements `com.marklogic.client.io.marker.StructureWriteHandle`. The Java API includes `StructureWriteHandle` implementations that support creating a structure in XML or JSON from input sources such as a string (`StringHandle`), a file (`FileHandle`), a stream (`InputStreamHandle`), and popular abstractions (`DOMHandle`, `DOM4JHandle`, `JDOMHandle`). For a complete list of implementations, see the Java API JavaDoc.

Follow this procedure to create a combined query using a handle:

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

2. Create a JSON or XML representation of the query, using a text editor or other tool or library. For syntax details, see Syntax in the *REST Application Developer's Guide*. The following example uses `String` for the raw representation:

```
String rawXMLQuery =
    "<search:search "+
        "xmlns:search='http://marklogic.com/appservices/search'>"+
      "<search:query>"+
        "<search:term-query>"+
          "<search:text>neighborhoods</search:text>"+
        "</search:term-query>"+
        "<search:value-constraint-query>"+
          "<search:constraint-name>industry</search:constraint-name>"+
          "<search:text>Real Estate</search:text>"+
        "</search:value-constraint-query>"+
      "</search:query>"+
      "<search:options>"+
        "<search:constraint name='industry'>"+
          "<search:value>"+
            "<search:element name='industry' ns=''/>"+
          "</search:value>"+
        "</search:constraint>"+
      "</search:options>"+
    "</search:search>";
```

3. If you express your query in XML, create a handle on your raw query, using a class that implements `StructureWriteHandle`. For example:

```
StringHandle rawHandle = new StringHandle(rawXMLQuery);
```

4. If you express your query in JSON, create a handle using a class that implements `StructureWriteHandle`, set the handle content format to JSON, and associate your raw query with the handle.

```
StringHandle rawHandle = new StringHandle();
rawHandle.withFormat(Format.JSON).set(rawJSONQuery);
```

5. Create a `RawCombinedQueryDefinition` from the handle. Optionally, include the name of persistent query options. For example:

```
// Use the default persistent query options
RawCombinedQueryDefinition querydef =
    queryMgr.newRawCombinedQueryDefinition(rawHandle);

// Use persistent options previously saved as "myoptions"
RawCombinedQueryDefinition querydef =
    queryMgr.newRawCombinedQueryDefinition(rawHandle, "myoptions");
```

6. Perform a search using the `RawCombinedQueryDefinition` and a results handle.

```
SearchHandle resultsHandle =
    queryMgr.search(querydef, new SearchHandle());
```

For a complete example of searching with a combined query, see `com.marklogic.client.example.cookbook.RawCombinedSearch` in the `example/` directory of your Java API installation.

### 3.7.2 Interaction with Persistent Query Options

Dynamic query options supplied in a combined query are merged with persistent and default options that are in effect for the search. If the same non-constraint option is specified in both the combined query and persistent options, the setting in the combined query takes precedence.

Constraints are overridden by name. That is, if the dynamic and persistent options contain a `<constraint/>` element with the same `name` attribute, the definition in the dynamic query options is the one that applies to the query. Two constraints with different name are both merged into the final options.

For example, suppose the following query options are installed under the name `my-options`:

```
<options xmlns="http://marklogic.com/appservices/search">
  <fragment-scope>properties</fragment-scope>
  <return-metrics>false</return-metrics>
  <constraint name="same">
    <collection prefix="http://server.com/persistent/"/>
  </constraint>
  <constraint name="not-same">
    <element-query name="title" ns="http://my/namespace" />
  </constraint>
</options>
```

Further, suppose you use the following raw XML combined query to define dynamic query options:

```
<search xmlns="http://marklogic.com/appservices/search">
  <options>
    <return-metrics>true</return-metrics>
    <debug>true</debug>
  <constraint name="same">
    <collection prefix="http://server.com/dynamic/"/>
  </constraint>
    <constraint name="different">
      <element-query name="scene" ns="http://my/namespace" />
    </constraint>
  </options>
</search>
```

You can create a `RawQueryDefinition` that encapsulates the combined query and the persistent options:

```
StringHandle rawQueryHandle =
    new StringHandle(...);
RawCombinedQueryDefinition querydef =
    queryMgr.newRawCombinedQueryDefinition(
        rawQueryHandle, "my-options");
```

The query is evaluated with the following merged options. The persistent options contribute the `fragment-scope` option and the constraint named `not-same`. The dynamic options in the combined query contribute the `return-metrics` and `debug` options and the constraints named `same` and `different`. The `return-metrics` setting and the constraint named `same` from `my-options` are discarded.

```
<options xmlns="http://marklogic.com/appservices/search">
  <fragment-scope>properties</fragment-scope>
  <return-metrics>true</return-metrics>
  <debug>true</debug>
  <constraint name="same">
    <collection prefix="http://server.com/dynamic/"/>
  </constraint>
  <constraint name="different">
    <element-query name="scene" ns="http://my/namespace" />
  </constraint>
  <constraint name="not-same">
    <element-query name="title" ns="http://my/namespace" />
  </constraint>
</options>
```

### 3.7.3 Performance Considerations

Using persistent query options usually performs better than using dynamic query options. In most cases, the performance difference between the two methods is slight.

When MarkLogic Server processes a combined query, the per request query options must be parsed and merged with named and default options on every search. When you only use persistent named or default query options, you reduce this overhead.

If your application does not require dynamic per-request query options, you should use a `QueryOptionsManager` to persist your options under a name and associate the options with a simple `StringQueryDefinition` or `StructuredQueryDefinition`.

## 3.8 Search On Tuples (Tuples Query / Values Query)

You can return values and tuples (co-occurrences) through the Java API. Value and tuple searches require the appropriate range indexes are configured on your MarkLogic Server database. For background on values and co-occurrences, see Browsing With Lexicons in the *Search Developer's Guide*.

This section includes the following parts:

- Values Search

- Tuples Search

### 3.8.1 Values Search

The following returns values through the Java API:

The following are the basic steps to search on values:

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

2. Create a `ValuesDefinition` object using the query manager. In the following example, the parameters define a named values constraint (`myvalue`) defined in previously persisted query options (`valueoptions`):

```
// build a search definition
ValuesDefinition vdef =
    queryMgr.newValuesDefinition("myvalue", "valuesoptions");
```

3. Configure additional values or tuples search properties, as needed. For example, call `setAggregate()` to set the name of the aggregate function to be applied as part of the query.

```
vdef.setAggregate("correlation", "covariance");
```

4. Run a search with the `ValuesDefinition` object as an argument, returning a `ValuesHandle` object. Note that the tuples search method is called `values()`, not `search()`.

```
ValuesHandle results = queryMgr.values(vdef, new ValuesHandle());
```

You can retrieve results one page at a time by defining a page length and starting position with the `QueryManager` interface. For example, the following code snippet retrieves a “page” of 5 values beginning with the 10th value.

```
queryMgr.setPageLength(5);
ValuesHandle result = queryMgr.values(vdef, new ValuesHandle(), 10);
```

For more information on values search concepts, see Returning Lexicon Values With search:values and Browsing With Lexicons in the *Search Developer’s Guide*.

### 3.8.2 Tuples Search

The following returns tuples (co-occurrences) through the Java API:

1. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

2. Create a `ValuesDefinition` object using the query manager. In the following example, the parameters define a named tuples constraint (`co`) defined in previously persisted query options (`tupleoptions`):

```
// build a search definition
ValuesDefinition vdef =
    queryMgr.newValuesDefinition("co", "tupleoptions");
```

3. Run a search with the `ValuesDefinition` object as an argument, returning a `TuplesHandle` object. Note that the tuples search method is called `tuples()`, not `search()`.

```
TuplesHandle results = queryMgr.tuples(vdef, new TuplesHandle());
```

You can retrieve results one page at a time by defining a page length and starting position with the `QueryManager` interface. For example, the following code snippet retrieves a "page" of 5 tuples beginning with the 10th one.

```
queryMgr.setPageLength(5);
TuplesHandle result = queryMgr.tuples(vdef, new TuplesHandle(), 10);
```

For more information on tuples search concepts, see Returning Lexicon Values With search:values and Browsing With Lexicons in the *Search Developer's Guide*.

## 3.9 Limiting A Search To Specific Collections And/Or A Directory

All query definition interfaces have `setCollections()` and `setDirectory()` methods. By calling `setDirectory(`*`directory_URI_string`*`)` on your query definition, you limit your search to that directory. By calling `setCollections(`*`list_of_collection_name_strings`*`)` on your query definition, you limit your search to those collections. You can call both and limit your search to collections and a single directory.

## 3.10 Transforming Search Results

You can make arbitrary changes to the results of a search or values query by applying a server-side transformation function to the results. This section covers the following topics:

- Writing a Search Result Transform
- Using a Search Result Transform

### 3.10.1 Writing a Search Result Transform

Search response transforms use the same interface and framework as content transformations applied during document ingestion, described in Writing Transformations in the *REST Application Developer's Guide*.

Your transform function receives the raw XML search result data prepared by MarkLogic Server as input, such as a document with a `<search:response/>` root element. Any customizations made by the `transform-results` query option or result decorators are applied before calling your transform function.

If your function produces XML output and the client application requested JSON output, MarkLogic Server will transform your output to JSON if one of the following conditions are met.

- Your function produces an XML document that conforms to the "normal" output from the search operation. For example, a document with a `<search:response/>` root element whose contents are changed in a way that preserves the normal structure.
- Your function produces an XML document with a root element in the namespace `http://marklogic.com/xdmp/json/basic` that can be transformed by `json:transform-to-json`.

Under all other circumstances, the output returned by your transform function is what is returned to the client application.

### 3.10.2 Using a Search Result Transform

To use a server transform function:

1. Create a transform function according to the interface described in Writing Transformations in the *REST Application Developer's Guide*.

2. Install your transform function on the REST API instance following the instructions in "Installing Transforms" on page 96.

3. Specify the transform function in your `QueryDefinition` by calling `setResponseTransform()`. For example:

```
QueryManager queryMgr = dbClient.newQueryManager();
StringQueryDefinition query = queryMgr.newStringDefinition();
query.setCriteria("cat AND dog");

query.setResponseTransform(new ServerTransform("example"));
```

You are responsible for specifying a handle type capable of interpreting the results produced by your transform function. The `SearchHandle` implementation provided by the Java API only understands the search results structure that MarkLogic Server produces by default.

## 3.11 Generating Search Term Completion Suggestions

Use `com.marklogic.client.query.QueryManager.suggest()` to generate search term completion suggestions that match a wildcard terminated string. For example, if the user enters the text "doc" into a search box, you can use `suggest()` with "doc" as string criteria to retrieve a list of terms matching "doc*", and then display them to user. This service is analogous to calling the XQuery function `search:suggest` or the REST API method `GET /version/suggest`.

The following topics are covered:

- Basic Steps
- Example: Generating Search Suggestions
- Where to Find More Information

### 3.11.1 Basic Steps

Use the following procedure to retrieve search term completion suggestions:

1. Configure at least one database index on the XML element, XML attribute, or JSON key values you want to include in the search for suggestions. For performance reasons, a range or collection index is recommended over a word lexicon; for details, see `search:suggest`.

2. Create and install persistent query options that use your index as a suggestion source by including it in the definition of a `default-suggestion-source` or `suggestion-source option`. For details, see Search Term Completion Using search:suggest in the *Search Developer's Guide* and "Creating Persistent Query Options From Raw JSON or XML" on page 68.

3. Instantiate a `QueryManager`. The manager deals with interaction between the client and the database.

```
QueryManager queryMgr = client.newQueryManager();
```

4. Use the query manager to obtain a `SuggestDefinition` object.

```
SuggestDefinition sd = queryMgr.newSuggestDefinition();
```

5. Configure the definition with the string for which to retrieve suggestions. For example, the following call configures the operation to return matches to the wildcard string "doc*":

```
sd.setStringCriteria("doc");
```

6. Optionally, associate persistent query options with the suggest definition. You can skip this step if your default query options include one or more `suggestion-source` or `default-suggestion-source` options. Otherwise, specify the name of previously installed query options that include `suggestion-source` and/or `default-suggestion-source` settings.

```
sd.setOptions("opt-suggest");
```

7. Optionally, configure additional properties, such as the maximum number of suggestions to return or additional string queries with which to filter the results. For example:

```
sd.setLimit(5);
sd.setQueryStrings("prefix:xdmp");
```

8. Retrieve the suggestions using your suggest definition and query manager:

```
String[] results = queryMgr.suggest(sd);
```

### 3.11.2 Example: Generating Search Suggestions

This example walks you through configuring your database and REST instance to try retrieving search suggestions. The Documents database is assumed in this example, but you can use any database. This example has the following parts:

1. Initialize the Database
2. Install Query Options
3. Get Search Suggestions

#### 3.11.2.1 Initialize the Database

Run the following query in Query Console to load the sample data into your database, or use a `DocumentManager` to insert equivalent documents into the database. The example will retrieve suggestions for the `<name/>` element, with and without a constraint based on the `<prefix/>` element.

```
xdmp:document-insert("/suggest/load.xml",
  <function>
    <prefix>xdmp</prefix>
    <name>document-load</name>
  </function>
  );
xdmp:document-insert("/suggest/insert.xml",
  <function>
    <prefix>xdmp</prefix>
    <name>document-insert</name>
  </function>
  );
xdmp:document-insert("/suggest/query.xml",
  <function>
    <prefix>cts</prefix>
    <name>document-query</name>
  </function>
  );
xdmp:document-insert("/suggest/search.xml",
  <function>
    <prefix>cts</prefix>
    <name>search</name>
  </function>
  );
```

To create the range index used by the example, run the following query in Query Console, or use the Admin Interface to create an equivalent index on the `name` element. The following query assumes you are using the Documents database; modify as needed.

```
xquery version "1.0-ml";
import module namespace admin = "http://marklogic.com/xdmp/admin"
  at "/MarkLogic/admin.xqy";
admin:save-configuration(
  admin:database-add-range-element-index(
    admin:get-configuration(),
    xdmp:database("Documents"),
    admin:database-range-element-index(
    "string", "http://marklogic.com/example",
    "name", "http://marklogic.com/collation/", fn:false())
  )
);
```

### 3.11.2.2 Install Query Options

The example relies on the following query options. These options use the `<name/>` element as the default suggestion source. The value constraint named “prefix” is included only to illustrate how to use additional query to filter suggestions. It is not required to get suggestions.

```
<options xmlns="http://marklogic.com/appservices/search">
 <default-suggestion-source>
   <range type="xs:string" facet="true">
      <element ns="http://marklogic.com/example" name="name"/>
   </range>
 </default-suggestion-source>
 <constraint name="prefix">
   <value>
      <element ns="http://marklogic.com/example" name="prefix"/>
   </value>
 </constraint>
</options>
```

Install the options under the name `"opt-suggest"` using `QueryOptionsManager`, as described in “Creating Persistent Query Options From Raw JSON or XML” on page 68. For example, to configure the options using a string literal, do the following:

```
String options =
  "<options xmlns=\"http://marklogic.com/appservices/search\">" +
    "<default-suggestion-source>" +
      "<range type="xs:string" facet="true">" +
        "<element ns="http://marklogic.com/example" name="name"/>" +
      "</range>" +
    "</default-suggestion-source>" +
    "<constraint name="prefix">" +
      "<value>
        "<element ns="http://marklogic.com/example" name="prefix"/>" +
      "</value>" +
    "</constraint>" +
```

```
  "</options>";

StringHandle handle = new StringHandle(options);
QueryManager queryMgr = client.newQueryManager();

QueryOptionsManager optMgr =
    client.newServerConfigManager().newQueryOptionsManager();
optMgr.writeOptions("opt-suggest", handle);
```

### 3.11.2.3 Get Search Suggestions

To retrieve search suggestions, use `QueryManager.suggest()`. For example:

```
QueryManager queryMgr = client.newQueryManager();
SuggestDefinition sd = queryMgr.newSuggestDefinition();
sd.setStringCriteria("doc");
String[] results = queryMgr.suggest(sd);
```

The results contain the following suggestions derived from the sample input documents:

```
document-insert
document-load
document-query
```

Recall that the query options include a value constraint on the `prefix` element. You can use this constraint with the string query `prefix:xdmp` as filter so that the operation returns only suggestions occuring in a documents with a `prefix` value of xdmp. For example:

```
sd.setStringCriteria("doc");
sd.setQueryStrings("prefix:xdmp");
String[] results = queryMgr.suggest(sd);
```

Now, the results contain only `document-insert` and `document-load`. The function named `document-query` is excluded because the `prefix` value for this document is not xdmp.

## 3.11.3 Where to Find More Information

For more details on using search suggestions, including performance recommendations and additional examples, see the following:

- `search:suggest` (XQuery function)
- Search Term Completion Using search:suggest in *Search Developer's Guide*.

# 4.0 Query Options

This chapter describes how to use, write, read, and delete *query options*. In the MarkLogic XQuery Search API, a query options object is called an *options node*.

This chapter contains the following sections:


- Using Query Options
- Default Query Options
- Using QueryOptionsManager To Delete, Write, and Read Options
- Using Query Options With Search
- Using QueryOptionsBuilder
- Creating Persistent Query Options From Raw JSON or XML
- Validating Query Options With setQueryOptionValidation()


For details on each of the query options, see Appendix A: JSON Query Options Reference in the *REST Application Developer's Guide* for their JSON format version and Appendix B: XML Query Options Reference in the *REST Application Developer's Guide* for their XML format version. While there are a large number of options, in order to configure your searches properly and build persistent query options, you will need to familiarize yourself with them.

## 4.1 Using Query Options

Query options let you specify a set of options for search and apply them repeatedly to multiple searches. The individual options can specify the following:

- Define constraints that do not require indexes, such as word, value and element constraints.
- Define constraints that do require indexes, such as collection, field-value, and other range constraints.
- Control search characteristics such as case sensitivity and ordering.
- Extend the search grammar.
- Customize query results including pagination, snippeting, and filtering.

Query options can be persistent or dynamic. Persistent query options are stored on the REST Server and referenced by name in future queries. Dynamic query options are options created on a per-request basis. Choosing between the two is a trade off between flexibility and performance: Dynamic query options are the more flexible, but persistent query options usually provide better performance. You can use both persistent and dynamic query options in the same query. Dynamic query options are only available for operations that accept a `RawCombinedQueryDefinition`. For details, see "Apply Dynamic Query Options to Document Searches" on page 53.

Use a `QueryOptionsManager` object to manage persistent query options and store them on the REST Server. To see individual option values, use the appropriate `get()` command on a `QueryOptionsHandle`.

The persistent query options are the static part of the search, and are generally used for many different queries. For example, you might create persistent query options that define a range contraint on a date range index so that you can facet the results by date.

Additionally, many queries have a component that is constructed dynamically by your Java code. For example, you might change the result page, the query criteria (terms, facet values, and so on), or other dynamic parts of the query. The static and dynamic parts of the query are merged together during a search.

For details on specific query options, see Appendix A: JSON Query Options Reference and Appendix B: XML Query Options Reference in the *REST Application Developer's Guide*. While there are a large number of options, in order to configure your searches properly, you will need to familiarize yourself with them.

For additional examples, see Query Options Examples in the *Search Developer's Guide*.

## 4.2 Default Query Options

The MarkLogic Java API comes with predefined persistent query options called `default`. It acts just like any other options and is used if options are not specified elsewhere. You can read it into a handle, change values, and write it back out, where it will still be used as the default query options. While changing its values should not be done casually, this can be very useful if your site needs different default behaviors.

The default options are selected for optimal performance; searches run unfiltered, and document quality is not taken into consideration during scoring. If you install different default options, consider including the following options unless your application requires filtering or the use of document quality.

```
<options xmlns="http://marklogic.com/appservices/search">
  <search_option>unfiltered</search-option>
  <quality-weight>0</quality-weight>
</options>
```

If you delete `default`, the server will fall back to its own defaults.

## 4.3 Using QueryOptionsManager To Delete, Write, and Read Options

Interactions with the database are done via a manager object, in this case `QueryOptionsManager`. Use `com.marklogic.client.admin.QueryOptionsManager` to manage persistent query options that are stored on the REST server. Since query options are associated with the REST server configuration, to create a `QueryOptionsManager` you call `ServerConfigManager.newQueryOptionsManager()`.

As with all operations on `ServerConfigManager`, an application must authenticate as `rest-admin`. Note that any application that authenticates as `rest-reader` and `rest-writer` can use query options, but to write or delete them from the server requires `rest-admin`.

```
// create a manager for writing, reading, and deleting query options
QueryOptionsManager qoManager=
            client.newServerConfigManager().newQueryOptionsManager();
```

The simplest `QueryOptions` operation is deleting a stored one:

```
qoManager.deleteOptions("myqueryoptions");
```

To either read query options from the database or write query options to the database,you need a handle object that implements the `QueryOptionsHandle` interface. The API includes several handle classes that implement `QueryOptionsHandle`, including `StringHandle`, `BytesHandle`, `DOM4JHandle`, and `DOMHandle`. These interfaces allow you to work with query options as raw strings, XML, and JSON.

The following example reads in the options configuration called `myqueryoptions` from the server, then writes it out again.

```
qoHandle = new QueryOptionsReadHandle();

// read a query option configuration from the database
// qoHandle now contains the query option
// "myqueryoptions"
qoManager.readOptions("myqueryoptions", qoHandle);

// write the query option to the database
qoManager.writeOptions("myqueryoptions", qoHandle);
```

You can get a list of all named `QueryOptions` from the server via the `QueryOptionsListHandle` object:

```
QueryManager queryMgr = dbclient.newQueryManager();
QueryOptionsHandle qolHandle = new QueryOptionsListHandle();
queryMgr.optionsList(qolHandle);
Set<String> results = qolHandle.getValuesMap().keySet();
```

## 4.4 Using Query Options With Search

You can customize a query with query options in the following ways:

- Create persistent query options, save them to the REST server with an associated name, and then reference them by name when you construct a query. To use the default query options, omit an options name when you construct the query. The following example creates a string query that uses the options stored as “myoptions”:

  ```
  // Create a string query that uses persistent query options
  QueryManager qMgr = new QueryManager();
  ```

```
StringQueryDefinition qDef = qMgr.newStringDefinition("myoptions");
...
qMgr.search(qDef, resultsHandle);
```

- Embed dynamic query options in a combined query definition.

You can use both persistent and dynamic query options in the same search by including a query options name when constructing a combined query (`RawCombinedQueryDefinition`).

Persistent query options must be stored on the REST server before you can use them in a search. For details, see "Using QueryOptionsManager To Delete, Write, and Read Options" on page 65.

To construct persistent query options, use a handle class that implements `QueryOptionsHandle`, such as `StringHandle` or `DOMHandle`, or use the `QueryOptionsBuilder` class. Using a handle, you can create query options directly in XML or JSON; for details, see "Creating Persistent Query Options From Raw JSON or XML" on page 68. When you use `QueryOptionsBuilder`, the internal XML representation is created for you.

**Warning** The use of `QueryOptionsBuilder` is deprecated. This class will be removed in a future release.

To construct dynamic query options, use a handle that implements `StructureWriteHandle`, such as `StringHandle` or `DOMHandle` to create a combined query that includes an options component, then associate the handle with a `RawCombinedQueryDefinition`. For details, see "Apply Dynamic Query Options to Document Searches" on page 53.

## 4.5 Using QueryOptionsBuilder

**Warning** The use of `QueryOptionsBuilder` is deprecated. This class will be removed in a future release. For the preferred method, see "Creating Persistent Query Options From Raw JSON or XML" on page 68.

The `QueryOptionsBuilder` class simplifies constructing a query options handle. To start using the `QueryOptionsBuilder` class, define a `QueryOptionsHandle` and a `QueryOptionsBuilder` object.

```
builder = new QueryOptionsBuilder();
options = new QueryOptionsHandle();
```

Once you have your builder and handle objects, start with the handle. To populate the handle with options and values, you will use the either the `set` methods or the `with` methods. The set methods set values on the object, and the `with` methods `set` values and return the object.

The `QueryOptionsBuilder` object provides parameters for these methods. Consider a simple example of defining a word constraint:

```
options.setConstraints(builder.constraint("word",
        builder.word(builder.elementTermIndex(
                    new QName("Summary")) )));
```

Inside the `setConstraints()`, you want to add a constraint option and its value. That means you need to build a constraint, so you use the `builder.constraint()` method. A constraint needs a name and a source, and `builder.constraint()`'s signature is a word index specification. Looking at the JavaDoc or your Java tools for `QueryOptionsBuilder`, its `word` method builds an option and value to specify a word index.

To build up the Java expression, start with the following:

```
options.setConstraints(
  builder.constraint(..., ...));
```

The first argument is easy; it is a string for a constraint name, which results in the following:

```
options.withConstraints(
  builder.constraint("word", ...));
```

For the second argument, we need a term word index, and looking at the available methods and their JavaDoc, you use `builder.word()` to build the following:

```
options.withConstraints(
  builder.constraint("word",
                     builder.word(...)));
```

As described in the JavaDoc, `word()` takes a `TermSpec` for the index backing the word options. And `QueryOptionsBuilder` has an `elementTermIndex()` method that will build one for you:

```
options.withConstraints(
  builder.constraint("word",
                    builder.word(builder.elementTermIndex(...))));
```

The `elementTermIndex()` takes one argument, a QName of the name of the indexed element. That is something simple enough that it is not necessary to build it, so you can just use the name as the argument as follows:

```
options.withConstraints(
  builder.constraint("word", builder.word(
                builder.elementTermIndex(new QName("Summary")))));
```

The result define query options consisting of a constraint.

## 4.6 Creating Persistent Query Options From Raw JSON or XML

To create persistent query options from a raw XML or JSON representation, use any handle class that implements `com.marklogic.client.io.marker.QueryOptionsWriteHandle`. Follow this procedure to create persistent query options using a handle:

1. Create a JSON or XML representation of the query options, using the tools of your choice. The following example uses a String representation:

```
String xmlOptions =
  "<search:options "+
        "xmlns:search='http://marklogic.com/appservices/search'>"+
      "<search:constraint name='industry'>"+
        "<search:value>"+
          "<search:element name='industry' ns=''/>"+
        "</search:value>"+
      "</search:constraint>"+
  "</search:options>";
```

2. If you are using XML query options, create a handle that implements `QueryOptionsWriteHandle` and associate your options with the handle. For example:

```
StringHandle writeHandle = new StringHandle(xmlOptions);
```

3. If you are using JSON query options, create a handle that implements `QueryOptionsWriteHandle`, set the handle content format to JSON, and associate your options with the handle. For example:

```
StringHandle writeHandle = new StringHandle();
writeHandle.withFormat(Format.JSON).set(jsonOptions);
```

4. Save the options to the REST server using `QueryOptionsManager.writeOptions`. For example:

```
optionsMgr.writeOptions(optionsName, writeHandle);
```

For a complete example, see `com.marklogic.client.example.cookbook.QueryOptions` in the following directory of the Java API distribution:

```
example/com/marklogic/client/example/cookbook
```

The Java API includes `QueryOptionsWriteHandle` implementations that support constructing query options as XML or JSON using several alternatives to `String`. These alternatives include reading from a file (`FileHandle`) or stream (`InputStreamHandle`), and popular abstractions, such as DOM, DOM4J, and JDOM. For details, see the Java API JavaDoc.

You can use any handle that implements `QueryOptionsReadHandle` to fetch previously persisted query options from the REST server. The following example fetches the JSON representation of query options into a `String` object:

```
StringHandle jsonStringHandle = new StringHandle();
jsonStringHandle.setFormat(Format.JSON);

qoManager.readOptions("jsonoptions", jsonStringHandle);
```

## 4.7 Validating Query Options With setQueryOptionValidation()

Query options can be complex. By default, the server validates query options before writing them out to a database. This takes a small amount of time, but because the query options are usually created once and then persisted, it does not really make a difference.

If you do try to write out an invalid query options and validation is enabled (which is the default), you get a `400` error from the server and a `FailedRequestException` thrown.

If you want to turn validation off, you can do so by calling the following right after you create your `ServerConfigurationManager` object:

```
ServerConfigurationManager.setQueryOptionValidation(false)
```

Note that if validation is disabled and you have query options that turn out to be invalid, your searches will still run, but any invalid options will be ignored. For example, if you define an invalid constraint and then try to use it in a search, the search will run, but the constraint will not be used. The search results will contain a warning in cases where a constraint is not used. You can access those warnings via `SearchHandle.getWarnings()`.

# 5.0 Alerting

The MarkLogic Java API enables you to create applications that include client-side alerting capabilities through the `com.marklogic.client.alerting` package. You can use the RuleDefinition and RuleManager interfaces to create and maintain alerting rules and to test documents for matches to rules.

This chapter covers the following topics:


- Alerting Pre-Requisites
- Alerting Concepts
- Defining Alerting Rules
- Testing for Matches to Alerting Rules


## 5.1 Alerting Pre-Requisites

This feature depends internally upon the XQuery Alerting API and reverse query indexing. As such, you must have a valid alerting license key to use this feature.

You should enable "fast reverse searches" on the content database associated with your REST API instance. Enable fast reverse searches using the Admin Interface, as described in Indexes for Reverse Queries in *Search Developer's Guide*, or using the XQuery function `admin:database-set-fast-reverse-searches`.

Creating or delete alerting rules requires the `rest-writer` role, or equivalent privileges. All other alerting operations require the `rest-reader` role, or equivalent privileges.

## 5.2 Alerting Concepts

An *alerting application* is one that takes action whenever content matches a pre-defined set of criteria. For example, send an email notification to a user whenever a document about influenza is added to the database. In this case, the criteria might be "the abstract contains the word influenza", and the action is "send an email".

MarkLogic Server supports server-side alerting through the XQuery API and Content Processing Framework (CPF), and client-side alerting through the REST and Java APIs.

A server-side alerting application usually uses a "push" model. You register alerting rules and XQuery action functions with MarkLogic Server. Whenever content matches the rules, MarkLogic Server evaluates the action functions. For details, see Creating Alerting Applications in *Search Developer's Guide*.

By contrast, a client-side alerting application uses a "pull" alerting model. You register altering rules with MarkLogic Server, as in the push model. However, your application must poll MarkLogic Server for matches to the configured rules, and the application initiates actions in response to matches. This is the model used by the MarkLogic REST API.

An *alerting rule* is a query used in a reverse query to determine whether or not a search using that query would match a given document. A normal search query asks “What documents match these search criteria?” A reverse query asks “What criteria match this document?” In the influenza example above, you might define a rule that is a word query for “influenza”, with an element constraint of `<abstract/>`. Alerting rules are stored in the content database associated with your REST API instance.

MarkLogic Server provides fast, scalable rule matching by storing queries in alerting rules in the database and indexing them in the reverse query index. You must explicitly enable “fast reverse searches” on your content database to take advantage of the reverse quer index. For details, see Indexes for Reverse Queries in *Search Developer’s Guide*.

> **Note:** A valid alerting license key is required to use the reverse index and the REST API alerting features.

Use the procedures described in this chapter to create and maintain search rules and to test documents for matches to the rules installed in your REST API instance. Determining what actions to take in response to a match and initiating those actions is left to the application.

## 5.3 Defining Alerting Rules

An alerting rule is defined by a name, a query, and optional metadata. The core of a rule is the combined query that describes the search criteria to use in future match operations. A combined query encapsulates a string and/or structured query plus query options; for syntax details and examples, see Specifying Dynamic Query Options with Combined Query in *REST Application Developer’s Guide*.

Choose one of the following methods to define a rule:

- Defining a Rule Using RuleDefinition
- Defining a Rule in Raw XML
- Defining a Rule in Raw JSON

Note that although you can define a rule in JSON, it will be returned as XML when you read it back from the database.

### 5.3.1 Defining a Rule Using RuleDefinition

Follow this procedure to define a rule using `com.marklogic.client.alerting.RuleDefinition`:

1. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

```
DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
```

2. If you have not already done so, create a `com.marklogic.client.alerting.RuleManager`.

```
RuleManager ruleMgr = client.newRuleManager();
```

3. Create a `com.marklogic.client.admin.RuleDefinition` object and populate it with your rule name and data. Optionally, you can include a description and metadata.

```
RuleDefinition rule = new RuleDefinition(RULE_NAME, RULE_DESC);

String combinedQuery = ...; // see complete example, below
StringHandle qHandle = new StringHandle(combinedQuery);
rule.importQueryDefinition(qHandle);

RuleMetadata metadata = rule.getMetadata();
metadata.put(new QName("author"), "me");
```

4. Save the rule to the database by calling `RuleManager.writeRule()`.

```
ruleMgr.writeRule(rule);
```

The following example code snippet puts all the steps together. The example rule matches documents containing the term “xdmp”.

```
// create a manager for configuring rules
RuleManager ruleMgr = client.newRuleManager();
RuleDefinition rule = new RuleDefinition(RULE_NAME, RULE_DESC);

// Configure metadata
RuleMetadata metadata = rule.getMetadata();
metadata.put(new QName("author"), "me");

// Configure the match query
String combinedQuery =
    "<search:search "+
            "xmlns:search='http://marklogic.com/appservices/search'>"+
      "<search:qtext>xdmp</search:qtext>"+
      "<search:options>"+
        "<search:term>"+
          "<search:term-option>case-sensitive</search:term-option>"+
        "</search:term>"+
      "</search:options>"+
    "</search:search>";
StringHandle qHandle = new StringHandle(combinedQuery);
rule.importQueryDefinition(qHandle);

// Write the rule to the database
ruleMgr.writeRule(rule);
```

### 5.3.2 Defining a Rule in Raw XML

Follow this procedure to define a rule directly in XML. When creating the rule, use the template in Defining an Alerting Rule in *REST Application Developer’s Guide*.

1. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

```
DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
```

2. If you have not already done so, create a `com.marklogic.client.alerting.RuleManager`.

```
RuleManager ruleMgr = client.newRuleManager();
```

3. Create an XML representation of the rule, using a text editor or other tool or library.cription and metadata. The following example uses `String` for the raw representation.

```
String rawRule =
    "<rapi:rule xmlns:rapi='http://marklogic.com/rest-api'>"+
      "<rapi:name>"+RULE_NAME+"</rapi:name>"+
      "<rapi:description>An example rule.</rapi:description>"+
      "<search:search "+
              "xmlns:search='http://marklogic.com/appservices/search'>"+
        "<search:qtext>xdmp</search:qtext>"+
        "<search:options>"+
          "<search:term>"+
              "<search:term-option>case-sensitive</search:term-option>"+
          "</search:term>"+
        "</search:options>"+
      "</search:search>"+
      "<rapi:rule-metadata>"+
          "<author>me</author>"+
      "</rapi:rule-metadata>"+
    "</rapi:rule>";
```

4. Create a handle on your raw query, using a class that implements `RuleWriteHandle`. For example:

```
StringHandle handle = new StringHandle(rawRule);
```

5. Save the rule to the database by calling `RuleManager.writeRule()`.

```
ruleMgr.writeRule(RULE_NAME, handle);
```

The following example code snippet puts all the steps together. The example rule matches documents containing the term “xdmp”.

```
// create a manager for configuring rules
RuleManager ruleMgr = client.newRuleManager();

// Define the rule in raw XML
String rawRule =
  "<rapi:rule xmlns:rapi='http://marklogic.com/rest-api'>"+
    "<rapi:name>"+RULE_NAME+"</rapi:name>"+
    "<rapi:description>An example rule.</rapi:description>"+
    "<search:search "+
```

```
            "xmlns:search='http://marklogic.com/appservices/search'>"+
      "<search:qtext>xdmp</search:qtext>"+
      "<search:options>"+
        "<search:term>"+
          "<search:term-option>case-sensitive</search:term-option>"+
        "</search:term>"+
      "</search:options>"+
    "</search:search>"+
    "<rapi:rule-metadata>"+
        "<author>me</author>"+
    "</rapi:rule-metadata>"+
  "</rapi:rule>";

// create a handle for writing the rule
StringHandle handle = new StringHandle(rawRule);

// write the rule to the database
ruleMgr.writeRule(RULE_NAME, handle);
```

### 5.3.3 Defining a Rule in Raw JSON

Follow this procedure to define a rule directly in XML. When creating the rule, use the template in Defining an Alerting Rule in *REST Application Developer's Guide*.

1. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

   ```
   DatabaseClient client = DatabaseClientFactory.newClient(
        host, port, user, password, authType);
   ```

2. If you have not already done so, create a `com.marklogic.client.alerting.RuleManager`.

   ```
   RuleManager ruleMgr = client.newRuleManager();
   ```

3. Create a JSON representation of the rule, using a text editor or other tool or library.cription and metadata. The following example uses `String` for the raw representation.

   ```
   String rawRule =
            "{ \"rule\": {"+
              "\"name\" : \""+RULE_NAME3+"\","+
              "\"search\" : {"+
                "\"qtext\" : \"xdmp\","+
                "\"options\" : {"+
                  "\"term\" : { \"term-option\" : \"case-sensitive\" }"+
                "}"+
              "},"+
              "\"description\": \"A JSON example rule.\","+
              "\"rule-metadata\" : { \"author\" : \"me\" }"+
            "}}";
   ```

4. Create a handle using a class that implements `RuleWriteHandle`, set the handle content format to JSON, and associate your raw rule with the handle.

```
StringHandle handle = new StringHandle();
handle.withFormat(Format.JSON).set(rawRule);
```

5. Save the rule to the database by calling `RuleManager.writeRule()`.

```
ruleMgr.writeRule(RULE_NAME, handle);
```

The following example code snippet puts all the steps together. The example rule matches documents containing the term “xdmp”.

```
// create a manager for configuring rules
RuleManager ruleMgr = client.newRuleManager();

// Define the rule in raw JSON
String rawRule =
  "{ \"rule\": {"+
    "\"name\" : \""+RULE_NAME3+"\","+
    "\"search\" : {"+
      "\"qtext\" : \"xdmp\","+
      "\"options\" : {"+
        "\"term\" : { \"term-option\" : \"case-sensitive\" }"+
      "}"+
    "},"+
    "\"description\": \"A JSON example rule.\","+
    "\"rule-metadata\" : { \"author\" : \"me\" }"+
  "}}";

// Create a handle for writing the rule
StringHandle qHandle = new StringHandle();
qHandle.withFormat(Format.JSON);
qHandle.set(rawRule);

// Write the rule to the database
ruleMgr.writeRule(RULE_NAME3, qHandle);
```

## 5.4 Testing for Matches to Alerting Rules

Once you install alerting rules in your REST API instance, use `RuleManager.match()` to determine which rules match one or more input documents. You can select the input documents using a database query or database URIs, or by passing a transient document.

This section covers the following topics:

- Identifying Input Documents Using a Query
- Identifying Input Documents Using URIs
- Matching Against a Transient Document

- Filtering Match Results
- Transforming Alert Match Results

### 5.4.1 Basic Steps

Follow this procedure to test one or more documents to see if they match installed alerting rules. Identify the input documents using a query or URIs, or by passing in a transient input document.

1. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

```
DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
```

2. If you have not already done so, create a `com.marklogic.client.alerting.RuleManager`.

```
RuleManager ruleMgr = client.newRuleManager();
```

3. Find the rules that match your input documents by calling `RuleManager.match()`. The result is a list of RuleDefinition objects. The following example uses a query to identify the input documents.

```
StringQueryDefinition querydef = ...;
RuleDefinitionList matchedRules =
    ruleMgr.match(querydef, new RuleDefinitionList());
```

The `match()` method returns the definition of any rules matching your input documents.

You can further customize rule matching by limiting the match results to a subset of the installed rules or applying a server-side transformation to the match results. For details, see the JavaDoc for `RuleManager`.

For a complete example, see `com.marklogic.client.example.cookbook.RawClientAlert`.

### 5.4.2 Identifying Input Documents Using a Query

You can use a string query, structured query, or combined query to select the documents in the database that you want to test for rule matches. These instructions assume you are familiar with constructing queries using the Java API; for details, see “Searching” on page 39.

Use the following procedure to select input documents using a query:

1. Construct a string, structured, or combined query definition as described in “Searching” on page 39. The following example uses `StringQueryDefinition`.

```
QueryManager queryMgr = client.newQueryManager();
String criteria = "document";
StringQueryDefinition querydef = queryMgr.newStringDefinition();
querydef.setCriteria(criteria);
```

2. If you constructed a raw XML or JSON query definition, create a handle using a class that implements `StructureWriteHandle`. For example, if you created an XML query using `String`, create a `StringHandle`:

```
StringHandle rawHandle = new StringHandle(rawXMLQuery);
```

3. Call `RuleManager.match()`, passing in either a `QueryDefinition` or `StructureWriteHandle` to the document selection query.

```
RuleDefinitionList matchedRules =
    ruleMgr.match(querydef, new RuleDefinitionList());
```

For a complete example, see `com.marklogic.client.example.cookbook.RawClientAlert`.

You can limit the rules under consideration by passing an array of rule names to `RuleManager.match()`. You can limit the input documents to a subset of the input query results by specifying start and page length. For details, see the JavaDoc for `RuleManager`.

### 5.4.3 Identifying Input Documents Using URIs

You can select the documents you want to test for rule matches by specifying a list of document URIs to `RuleManager.match()`. Each URI must identify a document, not a database directory.

Use the following procedure to select input documents using URIs:

1. Construct a String array of document URIs.

```
String[] docIds = { "/example/doc1.xml", "/suggest/doc2.xml" };
```

2. Call `RuleManager.match()`, passing in the list of URIs.

```
RuleDefinitionList matchedRules =
    ruleMgr.match(docIds, new RuleDefinitionList());
```

You can limit the rules under consideration by passing an array of rule names to `RuleManager.match()`. For details, see the JavaDoc for `RuleManager`.

### 5.4.4 Matching Against a Transient Document

You can test for rule matches against a document that is not in the database by passing the transient document to `RuleManager.match()`.

1. Create a handle using a class that implements `StructureWriteHandle`. The following example uses a `String` as the source document.

```
String doc = "<prefix>xdmp</prefix>";
StringHandle handle = new StringHandle(doc);
```

2. Call `RuleManager.match()`, passing in a `StructureWriteHandle` to the document.

```
RuleDefinitionList matchedRules =
    ruleMgr.match(handle, new RuleDefinitionList());
```

You can limit the rules under consideration by passing an array of rule names to `RuleManager.match()`. For details, see the JavaDoc for `RuleManager`.

### 5.4.5 Filtering Match Results

By default, the result of an alert match includes all matching rules. You can limit the result to a subset of matching rules by passing a list of candiate rule names to `RuleManager.match()`. For example, the result of the following match includes at most the definitions of the rules named "one" and "two", even if more rules match the input query definition:

```
RuleManager ruleMgr = client.newRuleManager();
StringQueryDefinition querydef = ...;
String [] candidateRules = new String[] {"one", "two"};
RuleDefinitionList matchedRules =
    ruleMgr.match(querydef, 0L, QueryManager.DEFAULT_PAGE_LENGTH,
        candidateRules, new RuleDefinitionList());
```

### 5.4.6 Transforming Alert Match Results

You can make arbitrary changes to the results from a match request by applying a server-side XQuery transformation function to the results. This section covers the following topics:

- Writing a Match Result Transform
- Using a Match Result Transform

#### 5.4.6.1 Writing a Match Result Transform

Alert match transforms use the same interface and framework as content transformations applied during document ingestion, described in Writing Transformations in the *REST Application Developer's Guide*.

Your transform function receives the raw XML match result data prepared by MarkLogic Server as input, such as a document with a `<rapi:rules/>` root element. For example:

```
<rapi:rules xmlns:rapi="http://marklogic.com/rest-api">
  <rapi:rule>
    <rapi:name>one</rapi:name>
    <rapi:description>Rule 1</rapi:description>
    <search:search
        xmlns:search="http://marklogic.com/appservices/search">
      <search:qtext>xdmp</search:qtext>
    </search:search>
  </rapi:rule>
</rapi/rules>
```

If your function produces XML output and the client application requested JSON output, MarkLogic Server will transform your output to JSON only if one of the following conditions are met.

- Your function produces an XML document that conforms to the "normal" output from the search operation. For example, a document with a `<rapi:rules/>` root element whose contents are changed in a way that preserves the normal structure.
- Your function produces an XML document with a root element in the namespace `http://marklogic.com/xdmp/json/basic` that can be transformed by `json:transform-to-json`.

Under all other circumstances, the output returned by your transform function is what is returned to the client application.

### 5.4.6.2 Using a Match Result Transform

To use a server transform function:

1. Create a transform function according to the interface described in Writing Transformations in the *REST Application Developer's Guide*.

2. Install your transform function on the REST API instance following the instructions in "Installing Transforms" on page 96.

3. In your application, create a `ServerTransform` object to represent the installed transform, and pass it as a parameter on your call to `RuleManager.match()`. For example:

```
RuleManager ruleMgr = client.newRuleManager();
StringQueryDefinition querydef = ...;
RuleDefinitionList matchedRules =
    ruleMgr.match(querydef, 0L, QueryManager.DEFAULT_PAGE_LENGTH,
        new String[] {}, new RuleDefinitionList(),
        new ServerTransform("your-transform-name"));
```

You are responsible for specifying a handle type capable of interpreting the results produced by your transform function. The `RuleDefinitionList` implementation provided by the Java API only understands the match results structure that MarkLogic Server produces by default.

# 6.0 Transactions and Optimistic Locking

This chapter covers two different ways for locking documents during MarkLogic Server operations, *multi-statement transactions* and *optimistic locking.*

This chapter includes the following sections:

- Multi-Statement Transactions
- Optimistic Locking

## 6.1 Multi-Statement Transactions

The following sections cover how to put multiple MarkLogic Server operations in a single *multi-statement transaction*. Specifically, you *open* a transaction, perform multiple operations in it, and then either *rollback* or *commit* the transaction. This section includes the following parts:

- Transactions and the Java API
- Transaction Class
- Starting A Transaction
- Operations Inside A Transaction
- Rolling Back A Transaction
- Committing A Transaction
- Cookbook: Multistatement Transaction
- Transaction Management When Using a Load Balancer

For detailed information about transactions in MarkLogic Server, see Understanding Transactions in MarkLogic Server in the *Application Developer's Guide*.

### 6.1.1 Transactions and the Java API

A multi-statement transaction lets you ensure that all operations finish successfully or roll back the transaction such that the system's state is the same as it was before you opened the transaction. For example, you open a transaction, successfully create a document, and then try to perform a metadata operation on a different document that fails. Responding to the failure, you can rollback the document creation.

Since it was in a rolled back transaction, the metadata operation is not the only one that fails; all operations in the transaction are rolled back, resetting the program's and database's states such that the document was never created. However, if you commit the transaction, then the new document will exist.

A key point about MarkLogic Server multi-statement transactions is that rollbacks do not take place automatically on operation failure. It is up to the Java API developer to write code that checks if operations in a transaction succeed or fail, and, in the event of failure, have the rollback method called. Failure could be detected either by tests of your devising, or detecting that an exception has been thrown.

While you can read and search documents during transactions, most transaction operations are writes and deletes, which alter the database's state. A transaction's purpose is to ensure that either all or none of multiple changes to the database are made.

You can also specify a time limit, so if the transaction does not commit before time expires, it is automatically rolled back. However, you should never write code with the expectation that a timeout will roll back a transaction. The time limit serves as a failsafe, not as a programming tool.

Finally, you should be aware that ordinary Java API MarkLogic operations are automatically in a single operation transaction, and whenever an operation touches a document, it locks the document until that operation succeeds or fails. If the MarkLogic detects a deadlock, then the transaction is automatically restarted until either it completes or an exception is thrown (for example, by reaching a time limit for the update transaction). This all happens automatically, and you normally do not need to worry about it. The material in the following sections all deals with multi-statement transactions.

### 6.1.2 Transaction Class

Transactions are straightforward, once you understand they amount to a wrapper around a series of actions to guarantee either all of those actions are successful, or none of them ever happened. There are only three main operations, opening, committing, and rolling back, each of which will be covered in the next few sections.

`Transaction` is defined in the `com.marklogic.client` package.

- Start a transaction:

  ```
  DatabaseClient.openTransaction()
  ```

- Commit a transaction when it successfully finishes:

  ```
  Transaction.commit()
  ```

- Rollback a multi-statement transaction to reset any actions that have already occured in that transaction; for example, delete any created items, restore any deleted items, revert back any edits, etc.

  ```
  Transaction.rollback()
  ```

Finally, there is the `readStatus()` method, which lets you check if the transaction is still open (in other words, it has been opened, but you have not committed it or rolled it back yet).

### 6.1.3 Starting A Transaction

To start a transaction and obtain a `Transaction` object, call the `openTransaction()` method on a `DatabaseClient` object (since the transaction controls if database changes are made). To call `openTransaction()`, an application must authenticate as `rest-writer` or `rest-admin`. For example:

```
Transaction transaction = client.openTransaction();
```

You can also include a transaction name, which is rarely used, and time limit arguments. The `timeLimit` value is the number of seconds the transaction has to finish and commit before it is automatically rolled back. As previously noted, you should not depend on the time limit rolling back your transaction; it is only meant as a failsafe to end the transaction if all else fails.

```
Transaction transaction1 = client.openTransaction("MyTrans", 10);
```

### 6.1.4 Operations Inside A Transaction

Once created and opened, you pass the `Transaction` object to a document manager's `read()`, `write()`, or `delete()` methods, or a query manager's `search()` method to perform operations within the multi-statement transaction. For example:

```
// read a document inside a transaction
docMgr.read(myDocId1, handle, myTransaction);

// write a document inside a transaction
docMgr.write(myDocId1, handle, myTransaction);

// delete a document inside a transaction
docMgr.delete(myDocId2, myTransaction);
```

Of course, you could have several different transactions happening at once, and/or other users could also be running transactions on or sending requests to the same database. To prevent conflicts, whenever the server does something to a document while in a transaction, the database locks the document until that transaction either commits or rolls back. Because of this, you should commit or roll back your transactions as soon as possible to avoid slowing down your and possibly others' applications.

You can intermix commands which are not part of a transaction with transaction commands. Any command without a `Transaction` object argument is not part of a multi-statement transaction. However, you almost always want to group all commands for a given transaction together without interruption so you can commit or roll it back as fast as possible.

### 6.1.5 Rolling Back A Transaction

In case of an error or exception, call a transaction's `rollback()` method. The `rollback()` method cancels the remainder of the transaction, and reverts the database to its state prior to the transaction's start. With respect to server load, this is better than timing out the transaction. To roll back a transaction, your application must authenticate as `rest-writer` or `rest-admin`. Then just call:

```
transaction.rollback()
```

### 6.1.6 Committing A Transaction

Once all of a transaction's actions have successfully completed, you need to *commit* the transaction so that the database is actually changed by those actions. To commit, your application must authenticate as `rest-writer` or `rest-admin`. Then just call:

```
transaction.commit();
```

Once a transaction has been committed, it cannot be rolled back and the `transaction` object is no longer available for use. To perform another transaction, you must create a new `transaction` object.

### 6.1.7 Cookbook: Multistatement Transaction

See `com.marklogic.client.example.cookbook.MultiStatementTransaction` for a full example of how to use transactions. The Cookbook examples are in the Java API distribution in the following directory:

```
example/com/marklogic/client/example/cookbook
```

### 6.1.8 Transaction Management When Using a Load Balancer

This section applies only to client applications that use multi-statement transactions and interact with a MarkLogic Server cluster through a load balancer.

When you use a load balancer, it is possible for requests from your application to MarkLogic Server to be routed to different hosts, even within the same session. This has no effect on most interactions with MarkLogic Server, but operations that are part of the same multi-statement transaction need to be routed to the same host within your MarkLogic cluster. This consistent routing through a load balancer is called *session affinity.*

When you create a transaction, a `HostId` cookie is cached on the `Transaction` object. Whenever your application passes the `Transaction` object to a method that sends a request to MarkLogic Server, the Java API includes the `HostId` cookie in the request. You can configure your load balancer to use the `HostId` cookie to preserve session affinity.

The exact steps required to configure your load balancer to use the `HostId` cookie for session affinity depend upon your loading balancer. Consult your load balancer documentation for details.

If a request is not routed through a load balancer, the `HostId` cookie is ignored. The Java API does not persist the `HostId` cookie. The cookie does not include any session state. The cookie value is not used by the Java API.

## 6.2 Optimistic Locking

An application under *optimistic locking* creates a document only when the document does not exist and updates or deletes a document only when the document has not changed since this application last changed it. However, optimistic locking does not actually involve placing a lock on an object.

Optimistic locking is useful in environments where integrity is important, but contention is rare enough that it is useful to minimize server load by avoiding unnecessary multi-statement transactions.

This section includes the following sub-sections:

- Activating Optimistic Locking
- DocumentDescriptors
- Using Optimistic Locking

### 6.2.1 Activating Optimistic Locking

Optimistic locking relies on an opaque numeric identifier that is associated with the state of the document's content at a point of time. By default, the REST Server to which the Java API connects does not keep track of this identifier, but you can enable it for use by setting a property, and make it optional or required.

To expand, there is a number associated with every document. Whenever a document's content changes, the value of its number changes. By comparing the stored value of that number at a point in time with the current value, the REST Server can determine if a document's content has changed since the time the stored value was stored.

> **Note:** While this numeric identifier lets you compare state, and uses a numeric value to do so, this is *not* document versioning. The numeric identifier only indicates that a document has been changed, nothing more. It does not store multiple versions of the document, nor does it keep track of what the changes are to a document, only that it has been changed at some point. You cannot use this for change-tracking or archiving previous versions of a document.

Since this App Server configuration parameter applies either to all documents or none, it is implemented in the REST Server. This means it is part of the overall server configuration, and must be turned on and off via a `ServerConfigurationManager` object and thus requires `rest-admin` privileges. For more about server configuration management, see "REST Server Configuration" on page 90.

To activate optimistic locking, do the following:

```
// if not already done, create a database client
DatabaseClient client = DatabaseClientFactory.newClient(
   host, port, user, password, authType);

// create server configuration manager
ServerConfigurationManager configMgr =
                           client.newServerConfigManager();

// read the server configuration from the database
configMgr.readConfiguration();

// require content versions for updates and deletes
// use UpdatePolicy.VERSION_OPTIONAL to allow but not
// require identifier use. Use UpdatePolicy.MERGE_METADATA
// (the default) to deactive identifier use
configMgr.setUpdatePolicy(UpdatePolicy.VERSION_REQUIRED);

// write the server configuration to the database
configMgr.writeConfiguration();

// release the client
client.release();
```

Allowed values for `UpdatePolicy` are in the Enum `ServerConfigurationManager.UpdatePolicy`.

### 6.2.2 DocumentDescriptors

To work with a document's change identifier, you must create a `DocumentDescriptor` for the document. A `DocumentDescriptor` describes exactly one document and is created via use of an appropriately typed method for the document. For more information on document managers, see "Document Managers" on page 12.

```
// create a descriptor for versions of the document
DocumentDescriptor desc = docMgr.newDescriptor(docId);
```

You can also get a document's `DocumentDescriptor` by checking to see if the document exists. This code returns the specified document's `DocumentDesciptor` or, if the document does not exist, `null`:

```
DocumentDescriptor desc = docMgr.exists(docId);
```

### 6.2.3 Using Optimistic Locking

Each `read()`, `write()`, and `delete()` method for `DocumentManager` has both a version that uses a URI string parameter to identify the document to be read, written, or deleted, and an identical version that uses a `DocumentDescriptor` object instead. The descriptor is only populated with state when you read a document or when you check for a document's existence. When you write, the state changes, but is not reflected in the descriptor.

When `UpdatePolicy` is set to `VERSION_REQUIRED`, you must use the `DocumentDescriptor` versions of the `write()` (when modifying a document) and `delete()` methods. If the change identifier has not changed, the write or delete operation succeeds. If someone else has changed the document so that a new version has been created, the operation fails by throwing an exception.

> **Note:** There is no general notification when UpdatePolicy changes to VERSION_REQUIRED. If the policy changes to required and an application uses the URI string version of `read()`, etc., such requests will now fail and throw exceptions.

If you are creating a document under `VERSION_REQUIRED`, you either must not supply a descriptor, or if you do pass in a descriptor it must not have state. A descriptor is stateless if it is created through a `DocumentManager` and has not yet been populated with state by a `read()` or `exists()` method. If the document does not exist, the operation succeeds. If the document exists, the operation fails and throws an exception.

When `UpdatePolicy` is set to `VERSION_OPTIONAL`, if you do not supply an identifier value via the descriptor and use the `docId` versions of `write()` and `delete()`, the operation always succeeds. If you do supply an identifier value by using the `DocumentDescriptor` versions of `write()` and `delete()`, the same rules apply as above when the update policy is `VERSION_REQUIRED`.

The identifier value always changes on the server when a document's content changes there.

The "optimistic" part of optimistic locking comes from this not being an actual lock, but rather a means of checking if another application has changed a document since you last accessed it. If another application does try to modify the document, the Server does not even try to stop it from doing so. It just changes the document's identifier value.

So, the next time your application accesses the document, it compares the number it stored for that document with its current number. If they are different, your application knows the document has been changed since it last accessed the document. It could have been changed once, twice, a hundred times; it does not matter. All that matters is that it has been changed. If the numbers are the same, the document has not been changed since you last accessed it.

### 6.2.4 Cookbook: Version Control and Optimistic Locking

See `com.marklogic.client.example.OptimisticLocking` in the Cookbook for a full example of how to use and optimistic locking. The Cookbook examples are in the Java API distribution in the following directory:

```
example/com/marklogic/client/example/cookbook
```

# 7.0 Logging

`RequestLogger` objects are supplied to individual manager objects, most commonly document and query managers. You can choose to log content sent to the server as well as any requests. It is located in `com.marklogic.client.util`.

This chapter includes the following sections:


- Starting Logging
- Suspending and Resuming Logging
- Stopping Logging
- Log Entry Format
- Logging To The Server's Error Log


## 7.1 Starting Logging

First, you must obtain a `RequestLogger` object via `DatabaseClient`'s `newLogger()` method, which takes an argument of an output stream to send the log messages to. This output stream can be shared with other loggers outside of the MarkLogic Server Java API. You are responsible for flushing the output stream.

```
out = new ByteArrayOutputStream();
RequestLogger logger = client.newLogger(out);
```

To start logging, call the `startLogging()` method on a manager object with an argument of a `RequestLogger` object. For example:

```
MyDocumentManager.startLogging(logger)
```

There is only one logger for any given object. However, you can share a `RequestLogger` object among multiple manager objects, just by specifying the same `RequestLogger` object in multiple `startLogging()` method calls.

## 7.2 Suspending and Resuming Logging

By using `RequestLogger`'s `setEnabled()` method, you can pause and resume logging on any logger object. For example, to suspend logging:

```
logger.setEnabled(false)
```

To reenable logging:

```
logger.setEnabled(true)
```

To check if logging is enabled or not:

```
logger.isEnabled(); //returns a boolean
```

When you change a logger's enable status, it applies to all manager objects for which that `RequestLogger` object was used as an argument to `StartLogging()`.

## 7.3 Stopping Logging

To stop logging on a manager, call the `stopLogging()` method. If called on a manager not currently logging, nothing happens, not even an error or exception. The `RequestLogger` object associated with the manager is not destroyed by this method and you can reuse and restart it.

```
MyDocumentManager.stopLogging()
```

## 7.4 Log Entry Format

Two types of things can be logged once logging is turned on and enabled. Requests to the server are always logged. These include search requests, configuration requests, and all database requests. By default, only requests are logged.

You can use `RequestLogger`'s `setContentMax()` method to control how much content is logged. By giving it the constant `ALL_CONTENT` value, all content is logged. To revert to no content being logged, use the constant `NO_CONTENT`. If you use a numeric value, such as `1000`, the first that many content bytes are logged. Note that if the request is for a deletion, no content is logged.

`FileHandle` is an exception to the ability to log content. Only the name of the file is logged.

You can also retrieve a request logger's underlying print stream by calling `getPrintStream()` on the `RequestLogger` object. Once you access the log's print stream, writing to it adds your own messages to the log.

## 7.5 Logging To The Server's Error Log

You can also use `ServerConfigurationManager.setServerRequestLogging()` to turn logging requests to the server's error log on or off, based on the boolean argument you provide. This log's location is platform dependent. For details about log files in MarkLogic Server, see Log Files in the *Administrator's Guide*.

# 8.0 REST Server Configuration

REST Server configuration is done through a `ServerConfigurationManager` object located in package `com.marklogic.client.admin`. REST Server configuration deals with the underlying REST instance running in MarkLogic. You can configure REST Server properties, namespace bindings, query options, and transform and resource extensions.

Note that you can only configure aspects of the underlying REST instance with the Java API. MarkLogic Server administration is not exposed in Java, so things such as creating indexes, creating users, creating databases, assigning roles to users, and so on must be done via the MarkLogic Admin Interface or other means (for example the Admin API or Information Studio). For more information about administering MarkLogic Server, see the *Administrator's Guide*.

This chapter includes the following sections:


- Creating a Server Configuration Manager Object
- Reading and Writing Server Configuration Properties
- REST Server Properties
- Creating New Server-Related Manager Objects
- Namespaces
- Logging Namespace Operations


## 8.1 Creating a Server Configuration Manager Object

Using a `com.marklogic.client.DatabaseClient` object, call `newServerConfigManager()`

```
DatabaseClient client = DatabaseClientFactory.newClient(
   host, port, user, password, authType);

// create a manager for server configuration
ServerConfigurationManager configMgr =
                           client.newServerConfigManager();
```

Your application should only need one active `ServerConfigurationManager` at any time.

## 8.2 Reading and Writing Server Configuration Properties

Use `com.marklogic.client.admin.ServerConfigurationManager` to manage server configuration properties. To read the current server configuration values into the `ServerConfigurationManager` object, do:

```
configMgr.readConfiguration();
```

If your application changes these values, they will not persist unless written out to the server. To write the REST Server Configuration values to the server, do:

```
configMgr.writeConfiguration();
```

## 8.3 REST Server Properties

`com.marklogic.client.admin.ServerConfigurationManager` objects have `get` and `set` methods for the following server properties:

- `ContentVersionRequests`: Deprecated. Use `UpdatePolicy` instead.
- `DefaultDocumentReadTransform`: Name of the default transform applied to documents as they are read from the server. For information about document transforms, see "Content Transformations" on page 96.
- `QueryOptionsValidation`: Boolean specifying whether the server validates query options before storing them in configurations. For information about query options, see "Query Options" on page 64.
- `ServerRequestLogging`: Boolean specifying whether the REST Server logs requests to the MarkLogic Server error log (`ErrorLog.txt`). For performance reasons, you should only enable this when debugging your application. For information about logging, see "Logging" on page 88.
- `UpdatePolicy`: Value from the `ServerConfigurationManager.UpdatePolicy` enum specifying whether the system tries to detect if a document is "fresh" or not via use of an opaque numeric identifier and whether to merge or overwrite metadata on update. For more information, see "Optimistic Locking" on page 85.

## 8.4 Creating New Server-Related Manager Objects

Most manager objects described so far handle access to the database and its content, and accordingly are created via a method on a `DatabaseClient` object. The following managers handle listing, reading, writing, and deleting REST Server data and settings, rather than those of the database. Therefore, these managers are created by factory methods on a `ServerConfigurationManager` instead of a `DatabaseClient`.

The `ServerConfigurationManager` associated managers are:

- `NamespaceManager`: Namespace bindings. For details about namespaces, see "Namespaces" on page 92.
- `QueryOptionsManager`: Query options. For details, about query options, see "Query Options" on page 64.
- `ResourceExtensionsManager`: Resource service extensions. For details about resource service extensions, see "Extending the Java API" on page 101.
- `TransformExtensionManager`: Transform extensions. For details, about transform extensions, see "Content Transformations" on page 96.

## 8.5 Namespaces

Namespaces are similar to Java packages in that they differentiate between potentially ambiguous XML elements. With the Java API, you can define namespace bindings on the REST Server.

In XML and XQuery, element and attribute nodes are always in a namespace, even if it is the empty namespace (sometimes called no namespace) which has the name of the empty string (""). Each non-empty namespace has an associated URI, which is essentially a unique string that identifies the namespace. That string can be bound to a namespace prefix, which is a shorthand string used as an alias for the namespace in path expressions, element qnames, and variable declarations. Namespace operations in the Java Client API are used to define namespace prefixes on the REST Server so the client and server can share identical namespace bindings on XML elements and attributes for use in queries.

Specifically, for key-value searchs, if an element argument is in a namespace, you need to know which namespace it is in. This is also true for the attribute value, but is less commonly used. For example, if you have element as follows:

```
<f:foo xmlns:f="example.com">---</f:foo>
```

Now if you want to be able to pass `/f:foo`. So you want to configure the server so that the prefix `f` binds to namespace URI `example.com`.

Another usage example is in query configuration; when you are setting up a range index configuration, or specifying an XML element or element attribute, you need identical prefix bindings to the server in order to correctly pass the arguments to the server.

Note that a namespace URI can be bound to multiple prefixes, but a prefix can only be bound to one URI.

For more information about namespaces, see Understanding XML Namespaces in XQuery in the *XQuery and XSLT Reference Guide*, which provides a detailed description of XML namespaces and their use. This section includes the following parts:

- Namespaces Manager
- Getting Server Defined Namespaces
- Adding And Updating A Namespace Prefix
- Reading Prefixes
- Deleting Prefixes

### 8.5.1 Namespaces Manager

The `com.marklogic.admin.NamespacesManager` class provides editing for namespaces defined on the REST Server. To use `NamespacesManager`, the application must authenticate as `rest-admin`. Since namespaces are based on the REST Server, a new `NamespacesManager` is defined via `com.marklogic.client.admin.ServerConfigManager`.

```
NamespacesManager nsManager =
    client.newServerConfigManager().newNamespacesManager();
```

### 8.5.2 Getting Server Defined Namespaces

Use `com.marklogic.client.admin.NamespacesManager` to get all of the namespaces defined on the REST Server. For example:

```
nsManager.readAll();
```

This returns a `javax.xml.namespace.NamespaceContext` interface that includes all of the REST Server defined namespaces. You can run the following on the `NamespaceContext` object.

```
nsContext.getNamespaceURI(prefix-string);
nsContext.getPrefix(URI-string);
nsContext.getPrefixes(URI-string);
```

`getNamespaceURI()` returns the URI associated with the given prefix. `getPrefix()` returns one of the prefixes associated with the given URI. `getPrefixes()` returns an iterator of all the prefixes associated with the given URI.

In addition, by casting the `NamespaceContext` to `EditableNamespaceContext`, you can iterate over the complete set of prefixes and URIs:

```
EditableNamespaceContext c =(EditableNamespaceContext)nsMgr.readAll();
for (Entry e:c.entrySet()){
  prefix = e.getKey();
  nsURI = e.getValue();
...
}
```

### 8.5.3 Adding And Updating A Namespace Prefix

Use `com.marklogic.client.admin.NamespacesManager` to add a new namespace prefix. For example:

```
nsManager.addPrefix("ml", "http://marklogic.com/exercises");
```

The first argument is the prefix, and the second argument is the URI being associated with the prefix.

To update the value of an existing prefix, do the following:

```
nsManager.updatePrefix("ml", "http://marklogic.com/new_exercises");
```

Where the first argument is the prefix, and the second argument is the new URI bound to it.

### 8.5.4 Reading Prefixes

Use `com.marklogic.client.admin.NamespacesManager` to read, or get, the associated URI value, of a single prefix. For example:

```
nsManager.readPrefix("ml");
```

It returns the prefix's associated URI as a string.

In order to read, or get, all of the prefixes associated with a Namespace Manager, do the following:

```
NamespaceContext context = nsManager.readAll();
```

`NamespaceContext` is a standard `javax.xml` Interface for storing a set of namespace declarations on the client. With a `NamespaceContext` object, you can:

- Get the prefix for any URI for which a prefix-URI binding has been created in this `NamespaceServer`. The below would return its prefix, say, `"ml"`.

  ```
  context.getPrefix("http://marklogic.com/new_exercises");
  ```

- Get the URI for any prefix for which a prefix-URI binding has been created in this `NamespaceServer`. The below returns the URI `"http://marklogic.com/new_exercises"`

  ```
  context.getNamespaceURI("ml");
  ```

- Get all of the prefixes for any URI for which prefix-URI bindings have been created in this `NamespaceServer`. The below returns all the associated prefixes in an Iterator.

  ```
  context.getPrefixes(“http://marklogic.com/new_exercises);
  ```

### 8.5.5 Deleting Prefixes

To delete a single prefix from the namespaces manager, do:

```
nsManager.deletePrefix("ml");
```

To delete all of the prefixes defined under a `NamespaceManager`, do:

```
nsManager.deleteAll();
```

## 8.6 Logging Namespace Operations

As with all manager objects, you can start and stop logging operations on a `NamespacesManager` via the `startLogging()` and `stopLogging()` methods. For details on how to use the logging facility, see “Logging” on page 88.

# 9.0 Content Transformations

The MarkLogic REST API allows you to create custom content transformations and apply them during operations such as document ingestion and retrieval. You can also apply tranformations to search Transforms can be implemented as XQuery library modules or XSLT stylesheets, and can accept transform-specific parameters. Transforms can be applied on document reads and writes.

`ServerConfigurationManager` has the property `DefaultDocumentReadTransform` which can be set to the name of a content transformation. This transformation then will be automatically applied to every document when they are read from the database. By default, there is no default read transform; an admin has to set `DefaultDocumentReadTransform` to one.

As always, you must be `rest-admin` to do `ServerConfigurationManager` operations.

This chapter contains the following sections:


- Installing Transforms
- Using Transforms
- Writing Transformations


## 9.1 Installing Transforms

To install a transform on your server, do the following steps:

1. Create a `DatabaseClient` for connecting to the database.

```
DatabaseClient client = DatabaseClientFactory.newClient(
   host, port, user, password, authType);
```

2. Create a manager for transform extensions. Since extensions installed on the REST Server, use a `ServerConfigManager` to create a `TransformExtensionsManager`.

```
TransformExtensionsManager transMgr =
    client.newServerConfigManager().newTransformExtensionsManager();
```

3. Specify the metadata for the new transform extension, using an `ExtensionMetadata` object to contain it.

```
ExtensionMetadata metadata = new ExtensionMetadata();
metadata.setTitle("XML-TO-HTML XSLT Transform");
metadata.setDescription("This plugin transforms an XML document with a
                         known vocabulary to HTML");
metadata.setProvider("MarkLogic");
metadata.setVersion("0.1");
```

4. Get the transform's source code.

```
FileInputStream transStream = new FileInputStream(
              "scripts"+File.separator+TRANSFORM_NAME+".xsl");
```

5. Wrap the source code in a text handle.

```
InputStreamHandle handle = new InputStreamHandle(transStream);
```

6. Write the transform, its source code, and its metadata to the REST server.

```
transMgr.writeXSLTransform(TRANSFORM_NAME, handle, metadata);
```

7. Release the client.

```
client.release();
```

## 9.2 Using Transforms

Once you install a transform, you can apply when inserting a document into the database, when reading a document from the database, when retrieving search results, or when testing for alerting rule matches.

This section describes how to use transforms and includes the following parts:

- Transforming a Document When Reading It
- Transforming a Document When Writing It
- Transforming Search Results
- Transforming Alert Match Results
- Overall Transform Administration
- Reading Transforms
- Logging

### 9.2.1 Transforming a Document When Reading It

When you apply a write transform to a document during ingestion, the transform receives the document from the client application as input, and should produce the document to be written to the database as output.

To transform a document when reading it, do the following:

1. Create a `DatabaseClient` for connecting to the database.

```
DatabaseClient client = DatabaseClientFactory.newClient(
   host, port, user, password, authType);
docId = "/examples/mydoc.xml";
```

2. Create an appropriate Document Manager for the to be transformed document. In this case, we use a `TextDocumentManager`.

```
XMLDocumentManager docMgr = client.newXMLDocumentManager();
```

3. Create a handle for the document's content.

```
StringHandle readHandle = new StringHandle();
```

4. Optionally, specify the content's MIME type for the content. This is only needed if the transform supports content negotiation and changes the content from one MIME type to another.

```
readHandle.setMimetype("text/xml");
```

5. Specify the transform by declaring a new `ServerTransform` object using the transform's name as the argument.

```
ServerTransform transform = new ServerTransform(TRANSFORM_NAME);
// you can specify any parameters here too
```

6. Read the XML content file in, specifying that as it is read in, a transform is to be applied to it. The result is that the handle argument will contain the transformed content.

```
docMgr.read(docId, readHandle, transform);
```

7. Close the database client.

```
client.release();
```

### 9.2.2 Transforming a Document When Writing It

When you apply a read transform to a document, the transform receives the document from the database as input, and should produce the document to be returned to the client application as output.

To transform a document when writing it, do the following:

1. Create a `DatabaseClient` for connecting to the database and assign the name of the document to be transformed to a variable.

```
DatabaseClient client = DatabaseClientFactory.newClient(
   host, port, user, password, authType);
docId = "/examples/mydoc.xml";
```

2. Create an appropriate Document Manager for the document. In this case, we use a `TextDocumentManager`.

```
TextDocumentManager writeMgr = client.newTextDocumentManager();
```

3. Specify a document on the client.

```
FileInputStream docStream = docId);
```

4. Create a handle for the document's content.

```
InputStreamHandle writeHandle = new InputStreamHandle(docStream);
```

5. Optionally, specify the content's MIME type for the content. This is only needed if the transform supports content negotiation and changes the content from one MIME type to another.

```
writeHandle.setMimetype("text/xml");
```

6. Specify the transform by declaring a new `ServerTransform` object using the transform's name as the argument and then specify any parameter values.

```
ServerTransform transform = new ServerTransform(TRANSFORM_NAME);
transform.put("drop-font-tags", "yes");
```

7. Write out the content to the database, so that the transform stored there changes it.

```
writeMgr.write(docId, writeHandle, transform);
```

8. Close the database client.

```
client.release();
```

### 9.2.3 Transforming Search Results

When you apply a transform to search results, the transform receives the search response data prepared by MarkLogic Server as input, and should produce the output to be returned to the client application. For example, if the response is in XML, the input is a document with a `<search:response/>` root element.

For details, see "Transforming Search Results" on page 58.

### 9.2.4 Transforming Alert Match Results

When you apply a transform to the results of an alerting match, the transform receives the match results prepared by MarkLogic Server as input, and should produce the output to be returned to the client application. For example, if the response is in XML, the input is a document with a `<rapi:rules>` root element.

For details, see “Transforming Alert Match Results” on page 79.

### 9.2.5 Overall Transform Administration

You can list all currently installed transform extensions by doing the following:

```
String result = transMgr.listTransforms(
   new StringHandle().withFormat(Format.XML)).get();
// format can be JSON as well
```

By default, calling `listTransforms()` rebuilds the transform metadata to ensure the metadata is up to date. If you find this refresh makes discovery take too long, you can disable the refresh by setting the `refresh` parameter to false:

```
String result = transMgr.listTransforms(
   new StringHandle().withFormat(Format.XML), false).get();
```

Disabling the refresh can result in this request returning inaccurate information, but it does not affect the “freshness” or availability of the implementation of any transforms.

To delete a transform, effectively uninstalling it from the server do the following:

```
transMgr.deleteTransform(TRANSFORM_NAME);
```

### 9.2.6 Reading Transforms

To read the source code of an XQuery implemented transform into your application, do:

```
StringHandle textHandle = readXQueryTransform(TRANSFORM_NAME,
   new StringHandle()); // can be any text handle
```

To read the source code of an XSLT implemented transform into your application, do:

```
XMLReadHandle xHandle = readXSLTransform(TRANSFORM_NAME,
   new XMLReadhandle());
```

### 9.2.7 Logging

Since it is a manager, you can define a `RequestLogger` object and start and stop logging client requests to the `TransformExtensionsManager`. For more information, see “Logging” on page 88

```
RequestLogger logger = client.newLogger(stream);
transformsMgr.startLogging(logger);
transformsMgr.stopLogging();
```

## 9.3 Writing Transformations

You can create transformation using the REST API and then access them from the Java API. For details on writing transformations, see Writing Transformations in the *REST Application Developer’s Guide*.

# 10.0 Extending the Java API

This chapter describes how to extend the Java API functionality with resource service extensions, and contains the following sections:


- Introduction to Extending the Java API
- Creating a Resource Extension in XQuery
- Installing Resource Extensions
- Deleting Resource Extensions
- Listing Resource Extensions
- Using Resource Extensions
- Managing Dependent Libraries and Other Assets


## 10.1 Introduction to Extending the Java API

Resource service extensions extend the MarkLogic Java API by making XQuery library modules available for use within Java. A resource extension implements services for a server-side resource. For example, you can create a dictionary program resource extension that looks up words, checks spelling, and makes suggestions for not found words. The individual operations an application programmer may call, for example, `lookUpWords()`, `spellCheck()`, and so on, are the services that make up the resource extension. The following are the basic steps to making a resource extension available to the Java API:

1. Create an XQuery library module that implements the services for the resource.

2. Install the XQuery library module as an extension on the REST Server using `com.marklogic.client.admin.ResourceExtensionsManager`.

3. Make your resource extension available to Java applications by creating a wrapper class that is a subclass of `com.marklogic.client.extensions.ResourceManager`. Inside this class, access the resource extension methods using a `com.marklogic.client.extensions.ResourceServices` object obtained through the `ResourceManager.getServices()` method.

4. Use the methods of your `ResourceManager` subclass to access the services provided by the extension from the rest of your application.

The key objects for resource extentions in the Java API are:

- `ResourceExtensionsManager`, which manages creation, modification, and deletion of XQuery implementations of resource services on the REST Server.
- `ResourceManager`, the base class for classes that you write to provide client interfaces to resource services.
- `ResourceServices`, which supports calling the services for a resource. The resource services extension XQuery module must already be installed on the server via the `ResourceExtensionsManager` before `ResourceServices` can access it.

These objects are created via a `ServerConfigManager`, since resource services are associated with the server, not the database. You must connect to MarkLogic as a user with the `rest-admin` role to create and work with `ResourceExtensionsManager`.

For a complete example of implementing and using a resource service extension, see `com.marklogic.client.example.cookbook.ResourceExtension` in the `example/` directory of your Java API installation.

## 10.2 Creating a Resource Extension in XQuery

The Java API uses the same XQuery resource extensions as the REST API, and the guidelines for writing extensions are identical for use in the Java API as in the REST API. For details on extending the REST API with an XQuery resource extension, see Extending the REST API in the *REST Application Developer's Guide*.

## 10.3 Installing Resource Extensions

Before you can use a resource extension, you must install the XQuery implementation on MarkLogic Server as follows

1. If your resource extension XQuery library module depends on additional library modules, install these dependent libraries on MarkLogic Server. For details, see "Managing Dependent Libraries and Other Assets" on page 107.

2. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

```
DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
```

3. If you have not already done so, create a `com.marklogic.client.admin.ResourceExtensionsManager`. Note that the method for doing so is associated with a `ServerConfigManager`.

```
ResourceExtensionsManager resourceMgr =
    client.newServerConfigManager().newResourceExtensionsManager();
```

4. Define a `com.marklogic.client.admin.ExtensionMetadata` object and populate it with your resource extension's metadata. You can set title, description, provider name, version, and expected parameters. All metadata is optional. For example:

```
ExtensionMetadata metadata = new ExtensionMetadata();
metadata.setTitle("Spelling Dictionary Resource Services");
metadata.setDescription("This plugin supports spelling dictionaries");
metadata.setProvider("MarkLogic");
metadata.setVersion("0.1");
```

5. Optionally, define one or more objects containing method interface metadata using `com.marklogic.client.admin.ResourceExtensionsManager.MethodParameters`. The following example creates metadata for a GET method expecting one string parameter:

```
MethodParameters getParams = new MethodParameters(MethodType.GET);
getParams.add("my-uri", "xs:string?");
```

6. Create a text handle (such as an input stream and a handle associated with it) to receive the extension's source code. Use the `set()` method on the handle to associate it with the desired stream, as in the following example.

```
FileInputStream myStream = new FileInputStream("sourcefile.xqy");
InputStreamHandle handle = new InputStreamHandle(myStream);
handle.set (myStream);
```

7. Install the extension by calling the `writeServices()` method on the `ResourceExtensionsManager`, with arguments of the extension's name, the handle containing the source code, and extension and method metadata. For example:

```
resourceMgr.writeServices(DictionaryManager.NAME,handle,metadata,getParams);
```

8. When finished with the database, release the resources for the database connection by calling the `release()` method on the `DatabaseClient` object.

```
client.release();
```

The following code sample demonstrates the above steps. For a complete example, see `com.marklogic.client.example.cookbook.ResourceExtension` in the `example/` directory of your Java API distribution.

```
// create a manager for resource extensions
ResourceExtensionsManager resourceMgr =
  client.newServerConfigManager().newResourceExtensionsManager();

// specify metadata about the resource extension
ExtensionMetadata metadata = new ExtensionMetadata();
metadata.setTitle("Spelling Dictionary Resource Services");
metadata.setDescription("This plugin supports spelling dictionaries");
metadata.setProvider("MarkLogic");
metadata.setVersion("0.1");
```

```
// specify metadata about method interfaces
MethodParameters getParams = new MethodParameters(MethodType.GET);
getParams.add("my-uri", "xs:string?");

// acquire the resource extension source code
InputStream sourceStream = new FileInputStream("dictionary.xqy");

// create a handle on the extension source code
InputStreamHandle handle = new InputStreamHandle();
handle.set(sourceStream);

// write the resource extension to the database
resourceMgr.writeServices(DictionaryManager.NAME, handle,
                          metadata, getParams);
```

## 10.4 Deleting Resource Extensions

To delete a resource extension, call the `deleteServices()` method of `com.marklogic.client.admin.ResourceExtensionManager`. For example, assuming you have already obtained a `ResourceExtensionsManager` object, do the following:

```
resourceMgr.deleteServices(resourceName);
```

## 10.5 Listing Resource Extensions

To list all the installed extensions, use a handle as in the following example, which gets the extensions list in XML format:

```
String result = resourceMgr.listServices(
   new StringHandle().withFormat(Format.XML)).get();
```

By default, calling `listServices()` rebuilds the extension metadata to ensure the metadata is up to date. If you find this refresh makes discovery take too long, you can disable the refresh by setting the `refresh` parameter to false:

```
String result = resourceMgr.listServices(
   new StringHandle().withFormat(Format.XML), false).get();
```

Disabling the refresh can result in this request returning inaccurate information, but it does not affect the “freshness” or availability of the implementation of any extensions.

## 10.6 Using Resource Extensions

After you install the extension as described in “Installing Resource Extensions” on page 102, create a wrapper class that exposes the functionality of the extension to your application. The wrapper class should be a subclass of `com.marklogic.client.extensions.ResourceManager`. In the implementation of your wrapper class, use `com.marklogic.client.extensions.ResourceServices` to invoke the GET, PUT, POST and/or DELETE methods of the resource extension.

Use these guidelines in implementing your wrapper subclass:

1. Before using any services, initialize your `ResourceManager` subclass by passing it to `com.marklogic.client.DatabaseClient.init()`. For example:

```
public class DictionaryManager extends ResourceManager {
    static final public String NAME = "dictionary";
    ...

    public DictionaryManager(DatabaseClient client) {
         super();

        // Initialize the Resource Manager via the Database Client
       client.init(NAME, this);
    }
    ...
}
```

2. To pass parameters to a resource extension method, create a `com.marklogic.client.util.RequestParameters` object and add parameters to it. Each parameter is represented by a parameter name and value. Use the parameter names defined by the resource extension. For example:

```
//Build up the set of parameters for the service call
RequestParameters params = new RequestParameters();
params.add("service", "dictionary");
params.add("uris", uris);
```

3. Obtain a `com.marklogic.com.extensions.ResourceServices` object through the inherited protected method `getServices()`. For example:

```
public class DictionaryManager extends ResourceManager {
    ...
    public Document[] checkDictionaries(String. . . uris) {

        ...
        // get the initialized service object from the base class
        ResourceServices services = getServices();
        ...
    }
}
```

4. Use the `get()`, `put()`, `post()`, and `delete()` methods of `ResourceServices` to invoke methods of the resource extension on the server. For example:

```
ResourceServices services = getServices();
ServiceResultIterator resultItr = services.get(params, mimetypes);
```

The results from calling a resource extension method are returned as either a `com.marklogic.client.extensions.ResourceServices.ServiceResultIterator` or a handle on the appropriate content type. Use a `ServiceResultIterator` when a method can return multiple items; use a handle when it returns only one. Resources associated with the results are not released until the associated handle is discarded or the iterator is closed or discarded.

The code below combines all the guidelines together in a sample application that exposes dictionary operations. For the complete example, see the Cookbook example `com.marklogic.client.example.cookbook.ResourceExtension` in the `example/` directory of your Java API distribution.

```
public class DictionaryManager extends ResourceManager {
    static final public String NAME = "dictionary";
    private XMLDocumentManager docMgr;

    public DictionaryManager(DatabaseClient client) {
         super();

        // Initialize the Resource Manager via the Database Client
       client.init(NAME, this);
   }

    // Our first Java implementation of a specific service from
    // the extension
    public Document[] checkDictionaries(String. . . uris) {
        //Build up the set of parameters for the service call
        RequestParameters params = new RequestParameters();
        // Add the dictionary service parameter
        params.add("service", "dictionary");
        params.add("uris", uris);

        String[] mimetypes = new String[uris.length];
        for (int i=0; i < uris.length; i++) {
            mimetypes[i] = "application/xml";
        }

        // get the initialized service object from the base class
        ResourceServices services = getServices();

        // call the service implementation on the REST Server,
        // returning a ResourceServices object
        Service Result Iterator resultItr =
            services.get(params, mimetypes);

        //iterate over results, get content
        ...
        // release resources
        resultItr.close();

    }
    ...
}
```

## 10.7 Managing Dependent Libraries and Other Assets

This section covers installation and maintenance of XQuery libraries and other server-side assets used by your application. This includes dependent libraries needed by resource extensions and transformations, and replacement content generation functions usable for partially updates to documents and metadata.

The following topics are covered:

- Maintenance of Dependent Libraries and Other Assets
- Installing or Updating Assets
- Removing an Asset
- Retrieving an Asset List
- Retrieving an Asset

You can also manage assets using the MarkLogic REST API. For details, see Managing Dependent Libraries and Other Assets in the *REST Application Developer's Guide*.

### 10.7.1 Maintenance of Dependent Libraries and Other Assets

When you install or update a dependent library module or other asset as described in this section, the asset is replicated across your cluster automatically. There can be a delay of up to one minute between updating and availability.

MarkLogic Server does not automatically remove dependent assets when you delete the related extension or transform.

Since dependent assets are installed in the modules database, they are removed when you remove the REST API instance if you include the modules database in the instance teardown.

If you installed assets in a REST API instance using MarkLogic 6, they cannot be managed using the `/ext` service unless you re-install them using `/ext`. Reinstalling the assets may require additional changes because the asset URIs will change. If you choose not to migrate such assets, continue to maintain them according to the documentation for MarkLogic 6.

### 10.7.2 Installing or Updating Assets

Follow this procedure to install or update a library module or other asset in the modules database associated with your REST Server. If the REST Server is part of a cluster, the asset is automatically propagated throughout the cluster.

> **Note:** The modules database path under which you install an asset must begin with `/ext/`.

1. If you have not already done so, connect to the database, storing the connection in a `com.marklogic.client.DatabaseClient` object.

```
DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
```

2. If you have not already done so, create a `com.marklogic.client.admin.ExtensionLibrariesManager`. Note that the method for doing so is associated with a `ServerConfigManager`.

```
ExtensionLibrariesManager libMgr =
    client.newServerConfigManager().newExtensionLibrariesManager();
```

3. Associate a handle with the asset. The following example associates a FileHandle with the text file containing an XQuery module.

```
FileHandle handle =
    new FileHandle(new File("module.xqy")).withFormat(Format.TEXT));
```

4. Install the module in the modules database by calling `ExtensionLibrariesManager.write()`. For example:

```
libMgr.write("/ext/my/path/to/my/module.xqy", handle);
```

You can also specify asset-specific permissions by passing an `ExtensionLibraryDescriptor` instead of a simple path string to ExtensionLibrariesManager.write(). The following example uses an descriptor:

```
ExtensionLibraryDescriptor desc = new ExtensionLibraryDescriptor();
desc.setPath("/ext/my/path/to/my/module.xqy");
desc.addPermission("my-role", "my-capability");
...
libMgr.write(desc, handle);
```

To use a dependent library installed with `/ext` in your extension or transform module, use the same URI under which you installed the dependent library. For example, if a dependent library is installed with the URI `/ext/my/domain/my-lib.xqy`, then the extension module using this library should include an import of the form:

```
import module namespace dep="mylib" at "/ext/my/domain/my-lib.xqy";
```

### 10.7.3 Removing an Asset

To remove an asset from the modules database associated with the REST Server, call `com.marklogic.client.admin.ExtensionLibrariesManager.delete()`. For example:

```
DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
ExtensionLibrariesManager libMgr =
    client.newServerConfigManager().newExtensionLibrariesManager();

libMgr.delete("/ext/my/path/to/my/module.xqy");
```

You can also call `delete()` with a `ExtensionLibraryDescriptor`.

If the path passed to `delete()`, whether by `String` or descriptor, is a database directory path, all assets in the directory are deleted. If the path is a single asset, just that asset is deleted.

### 10.7.4 Retrieving an Asset List

You can retrieve a list of all the assets installed in the modules database associated with the REST Server by calling `com.marklogic.client.admin.ExtensionsLibraryManager.list`(). If you call `list()` with no parameters, you get a list of `ExtensionLibraryDescriptor` objects for all assets. If you call `list()` with a path, you get a similar list of descriptors for all assets installed in that database directory.

The following code snippet retrieves descriptors for all installed assets and prints the path of each one to stdout.

```
DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
ExtensionLibrariesManager libMgr =
    client.newServerConfigManager().newExtensionLibrariesManager();

ExtensionLibraryDescriptor[] descriptors = libMgr.list();
for (ExtensionLibraryDescriptor descriptor : descriptors) {
    System.out.println(descriptor.getPath());
}
```

### 10.7.5 Retrieving an Asset

To retrieve the contents of an asset installed in the modules database associated with a REST Server, call `com.marklogic.client.admin.LibrariesExtensionManager.read()`. You must first create a handle to receive the contents.

The following code snippet reads the contents of an XQuery library module into a string:

```
DatabaseClient client = DatabaseClientFactory.newClient(
     host, port, user, password, authType);
ExtensionLibrariesManager libMgr =
    client.newServerConfigManager().newExtensionLibrariesManager();

StringHandle handle =
    libMgr.read("/ext/my/path/to/my/module.xqy", new StringHandle());
```

# 11.0 Troubleshooting

This chapter describes how to troubleshoot errors while programming in the Java API, and contains the following sections:


- Error Detection
- General Troubleshooting Techniques


## 11.1 Error Detection

As you would expect, the Java API client indicates errors by throwing exceptions. It does not return errors or otherwise indicate problems by any other means. The exceptions are located in `com.marklogic.client` and are:

- `FailedRequestException`: Indicates a problem at the REST API level.
- `ForbiddenUserException`: Indicates credentials used to connect to a REST instance are not sufficient for the requested task. Equivalent to a `403` HTTP status code.
- `MarkLogicBindingException`: Indicates a problem binding a value.
- `MarkLogicInternalException`: Indicates a defect in the API. Call MarkLogic Support.
- `MarkLogicIOException`: `RuntimeException` Thrown when a code block internally throws `java.lang.IOException`.
- `MarkLogicServerException`: The MarkLogic REST Server threw an exception.
- `ResourceNotFoundException`: Thrown when the server responds with an HTTP `404` status.
- `UnauthorizedUserException`: Thrown when a user attempts an operation to which they do not have the rights for.

## 11.2 General Troubleshooting Techniques

The following are some general guidelines for troubleshooting your program.

- To troubleshoot unexpected search results, pass the query option for `debug`, which returns errors in the query options, and the `return-qtext` option, which returns the pre-parsed query text for the search.
- Remember that documents with no read permission are hidden.
- To troubleshoot exceptions, pay close attention to any messages returned from the server.
- Set the MarkLogic Server error log to `debug` and view the server log (`<marklogic-dir>/Logs/ErrorLog.txt`) for more details.
- To monitor the HTTP requests against the REST Server, look at the access logs under the `<marklogic-dir>/Logs` directory for your REST App Server (for example, `1234_AccessLog.txt` for the server running on port 1234).
- Configure managers with a request logger to confirm requests are correct.

- To troubleshoot extensions, first execute the XQuery code in an XQuery environment. Then look at the requests and server log.
- Check the query options builder output to make sure it is what you expect, either with `QueryOptionsHandle.toString()`, which outputs the XML representation of the query options, or by checking the stored options against what is expected. Errors reported by MarkLogic Server refer to the structure of this document.
- When you have a mismatch between query options and existing indexes, you can look at the `/v1/config/indexes?format=html` endpoint on your REST Server.
- If you want a closer look at the requests against the REST Server, use a network sniffer to watch the HTTP trafic against the REST Server. You can also try to execute an equivalent request for the REST API using cURL or some other HTTP client.

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If you have questions or comments, you may contact MarkLogic Technical Support at the following email address:

support@marklogic.com

If reporting a query evaluation problem, be sure to include the sample XQuery code.

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