

Design

PSE of

PSE Group

Fraunhofer Institute for Systems and Innovation Research ISI
Advisor: M.Sc. Ankush Meshram

Version 1.0

Contents

1	Design	1
1.1	Front-End	1
1.1.1	Class Diagram	1
1.1.2	Sequence Diagram	5
1.1.3	Activity Diagram	10
1.2	Client-server protocol	11
1.2.1	Requests from client to server:	11
1.2.2	Messages from server to client:	11
1.3	Back-End	12
1.3.1	Class Diagram	12
1.3.2	Sequence Diagram	24
1.3.3	Activity Diagram	26

1 Design

1.1 Front-End

1.1.1 Class Diagram

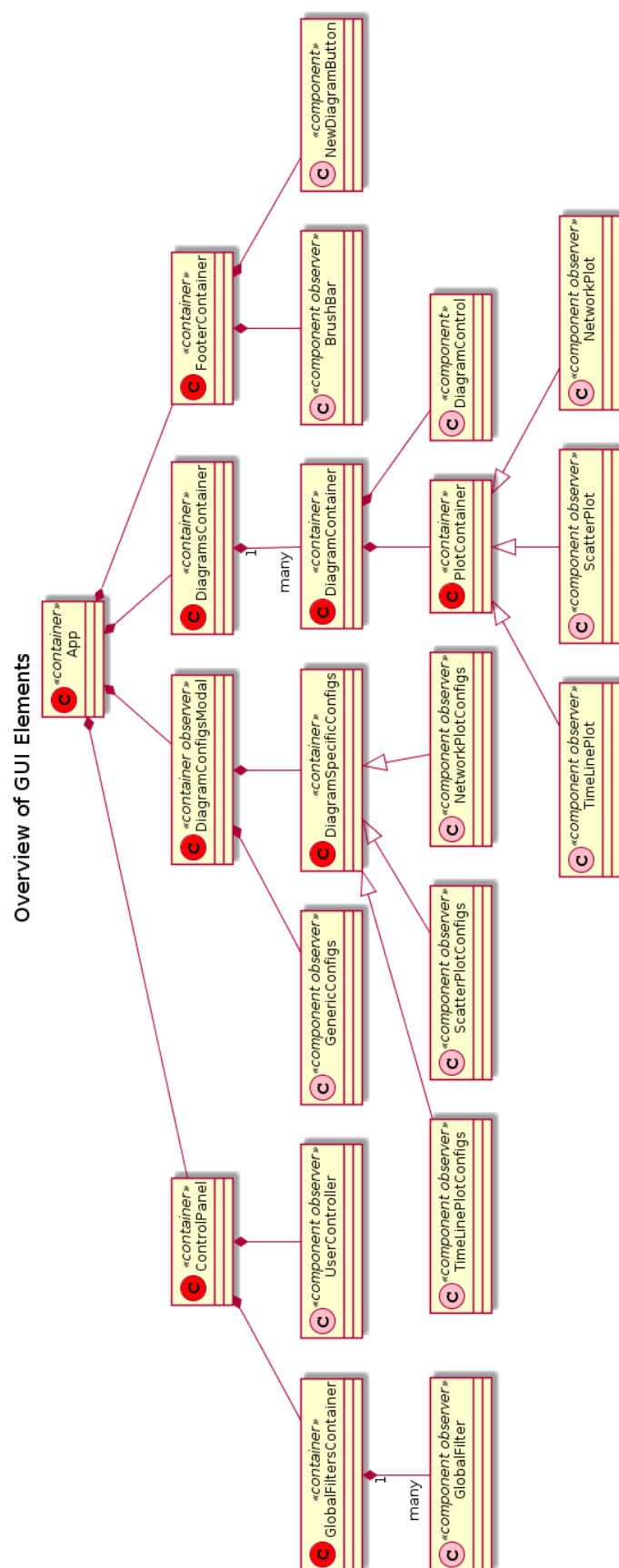


Figure 1: This diagram shows an overview of GUI elements and their relationships inside the main application, when the user has successfully logged in.

Representational Element Definitions

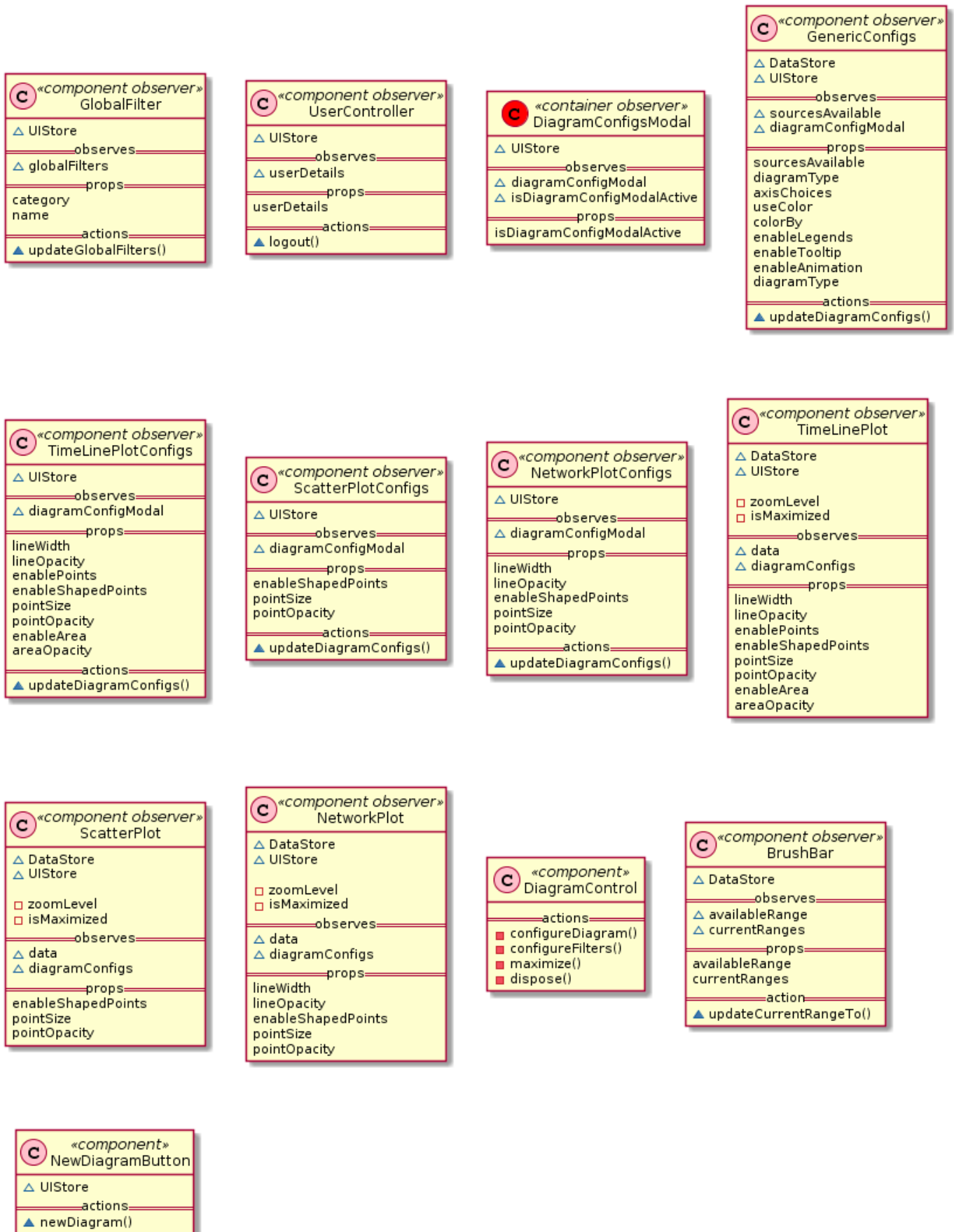


Figure 2: This diagram shows the definitions of all representational elements.

State Stores and Action Definitions

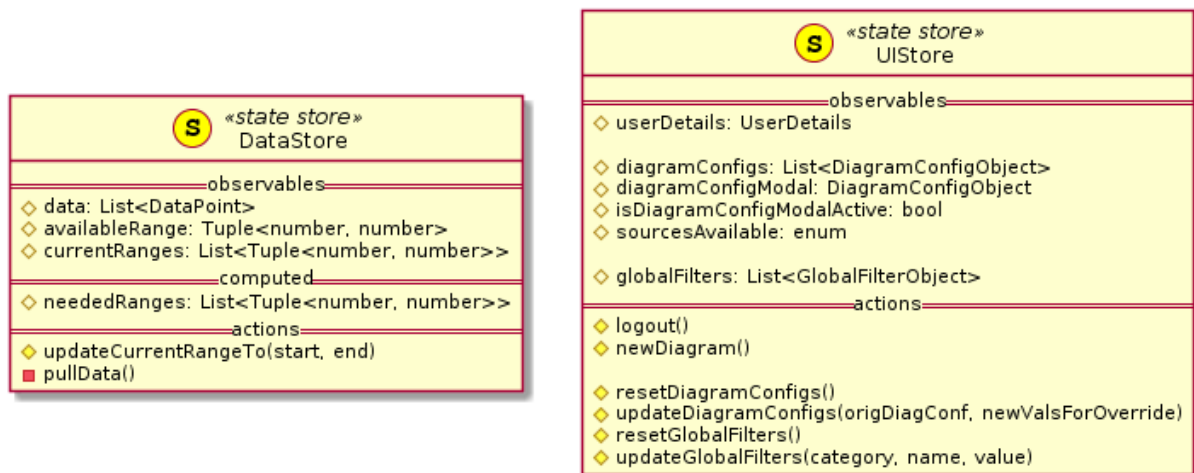


Figure 3: This diagram shows the design of the MobX state store objects and predefined actions to mutate the states.

Type Definitions

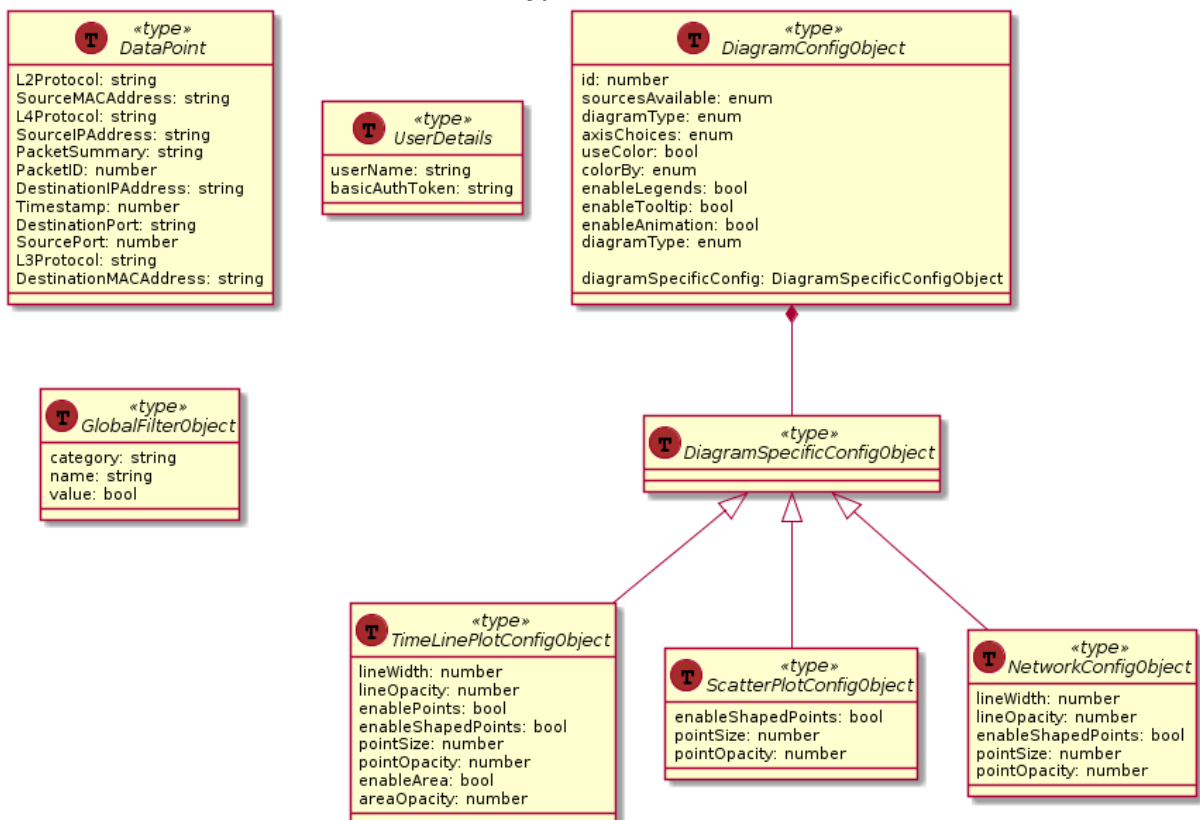
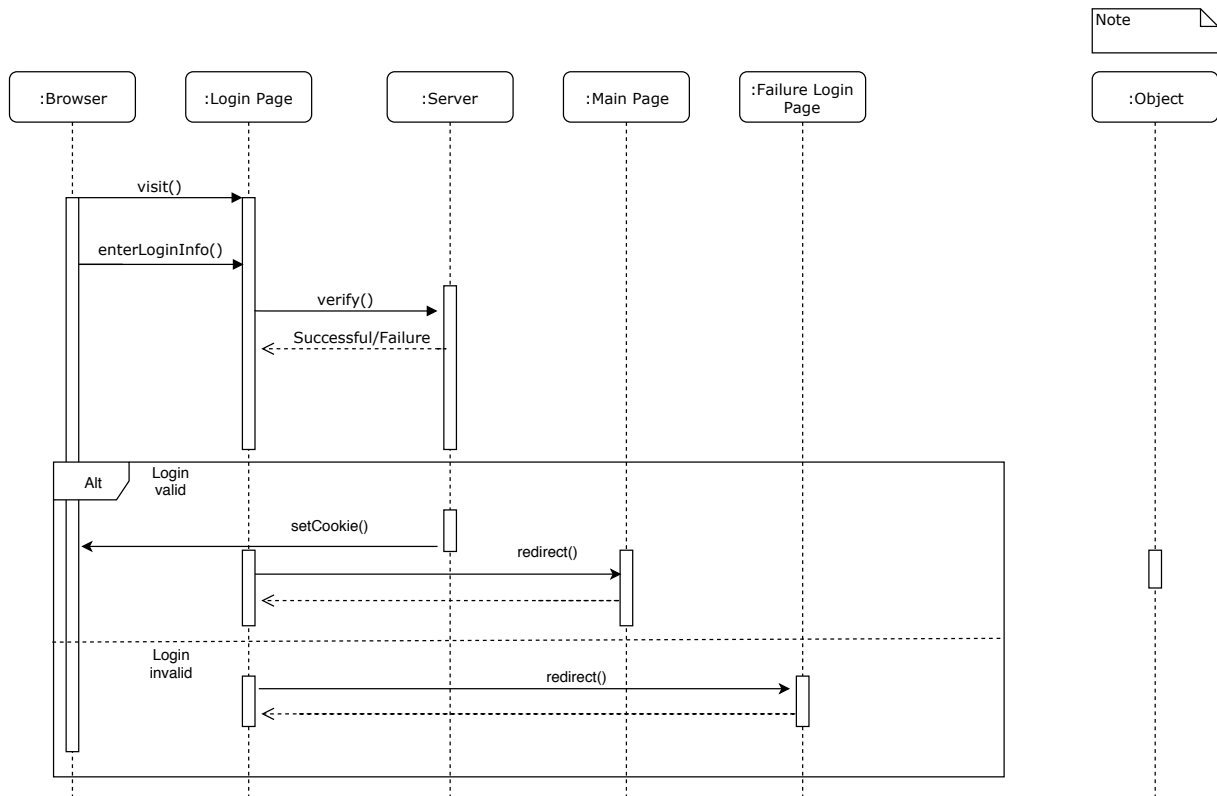
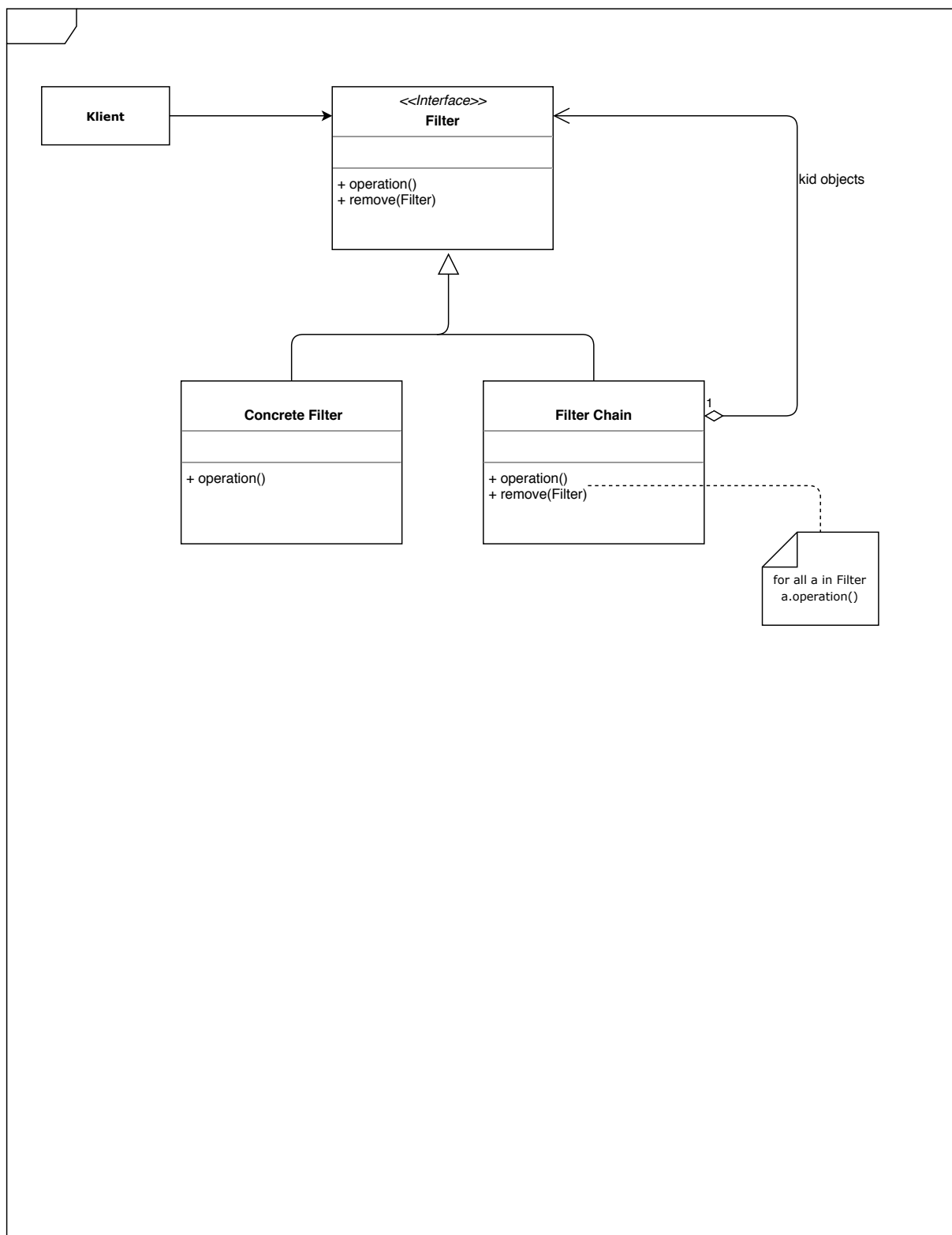


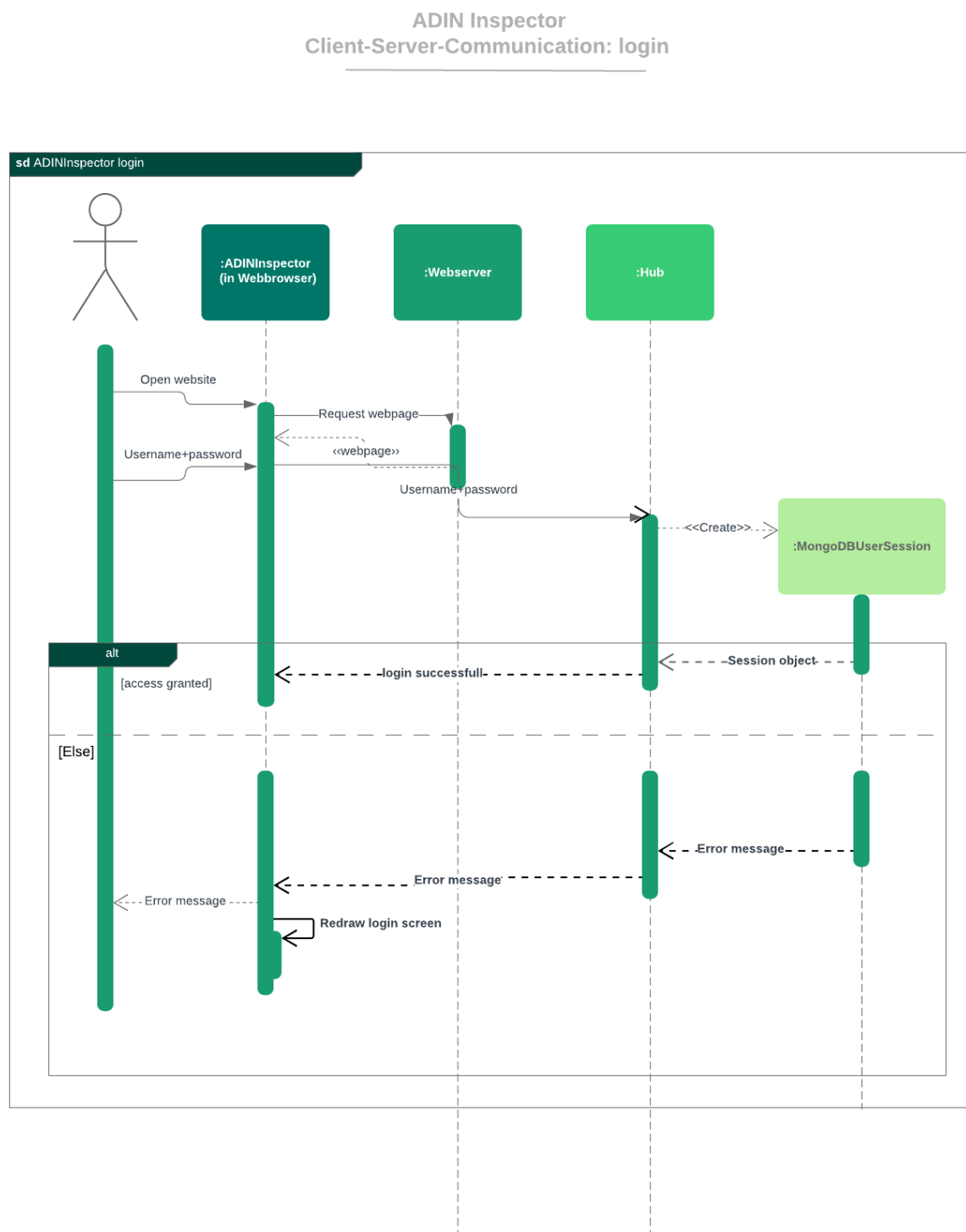
Figure 4: This diagram shows the definitions of custom types that are used in the MobX state stores.

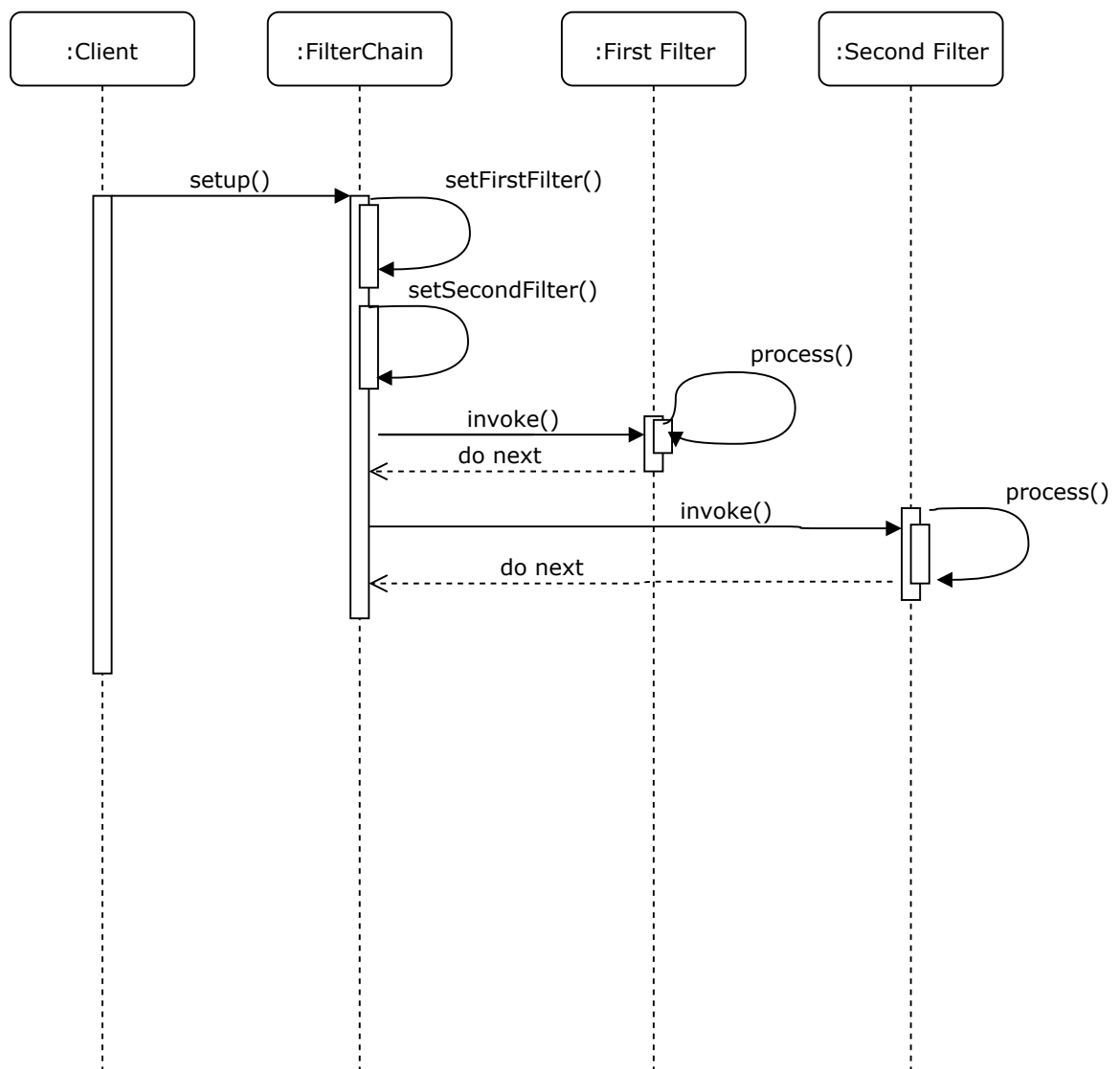
1.1.2 Sequence Diagram

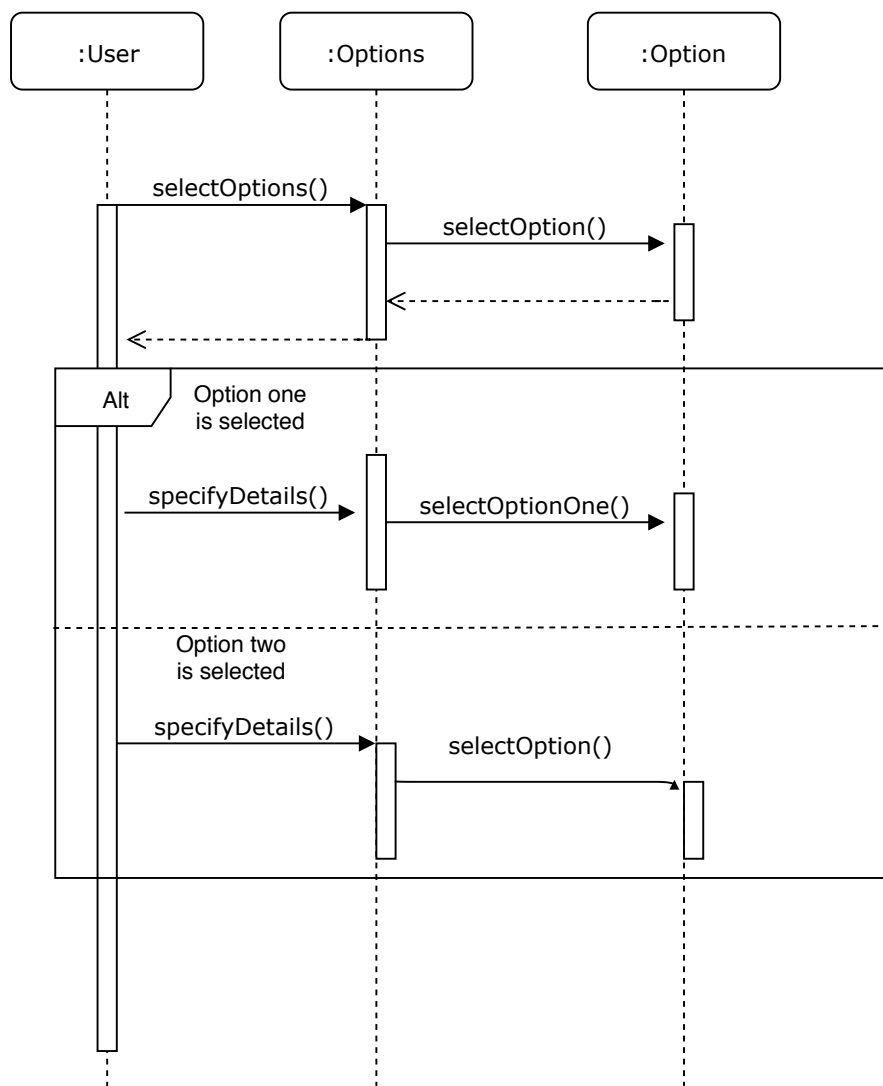




The following diagram shows an alternative view of the login sequence:







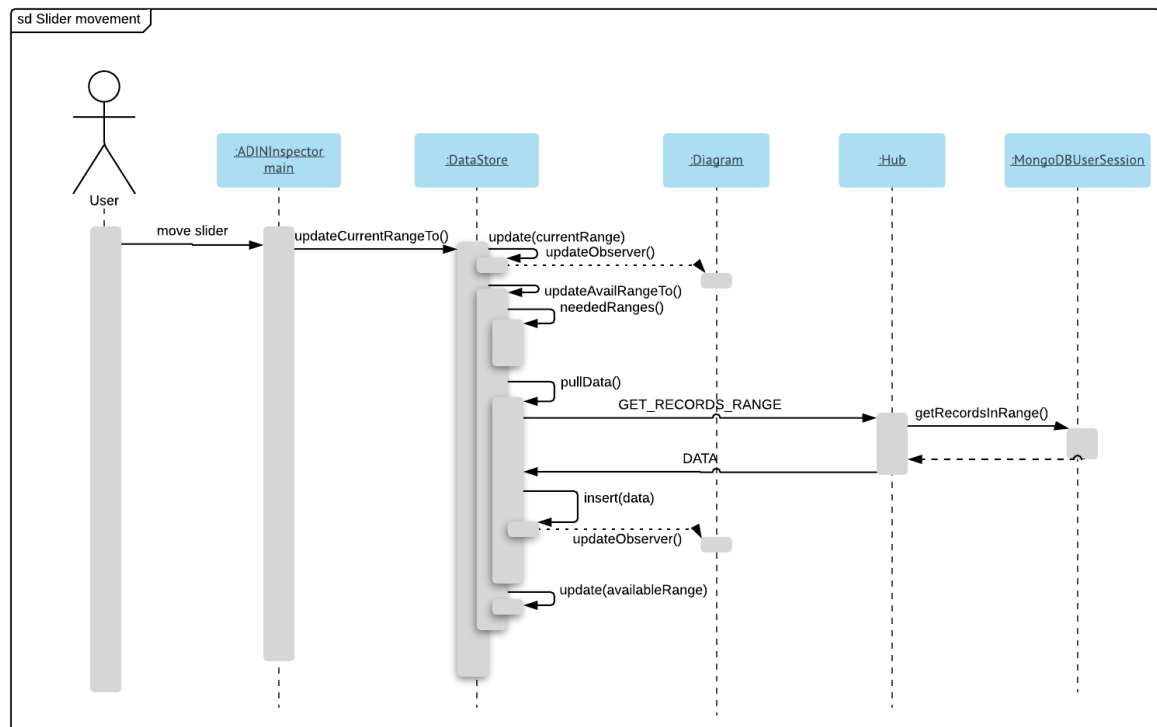


Figure 5: Sequence diagram for slider movement

This diagram shows the control flow for handling a movement of the slider by the user.

1.1.3 Activity Diagram

1.2 Client-server protocol

Messages between client and server are exchanged as strings in JSON format. In the following list words in angle brackets ("**<>**") are placeholders.

1.2.1 Requests from client to server:

- `getAvailableCollections`
syntax: {"cmd": "GET_AV_COLL"}
expected response: list of collections
- `getCollectionSize(collection)`
syntax: {"cmd": "GET_COLL_SIZE", "par": "<collection>"}
where <collection> is the name of a collection
expected response: collection size
- `getCollection(collection)`
syntax: {"cmd": "GET_COLL", "par": "<collection>"}
expected response: data set
- `getRecordsInRange(collection, key, start, end)`
syntax: {"cmd": "GET_RECORDS_RANGE", "par": "<collection>", "key": "<keyvalue>", "start": "<startvalue>", "end": "<endvalue>"}
where <key> is the name of a key in the given collection and <startvalue> and <endvalue> are valid values for this key
expected response: data set
- `getRecordsInRangeSize(collection, key, start, end)`
syntax: {"cmd": "GET_RECORDS_RANGE_SIZE", "par": "<collection>", "key": "<key-value>", "start": "<startvalue>", "end": "<endvalue>"}
expected response: collection size

1.2.2 Messages from server to client:

- list of collections
syntax: {"cmd": "LIST_COL", "par": ["<collection>"]}
where <collection> is the name of a collection
- collection size
syntax: {"cmd": "COLL_SIZE", "par": "<size>"}
where <size> is the number of records in this collection
- data set
syntax: {"cmd": "DATA", "par": [<record>]}
where each record is a JSON object

1.3 Back-End

This subsection describes the the back-end of the ADIN INSPECTOR. This comprises the communication with the client and how kafka interacts with the system. An overview of the system can be seen in Figure 6.

The connection to the client is handled in the class Hub which contains handlers for the network interface. This class uses a separate class (ClientProtocolHandler) to parse and handle requests from the handler. This setup is according to the strategy design pattern and allows easily modifying or even replacing the client server-protocol. The Hub class and the ClientProtocolHandler access the database via an object that implements the IUserSession interface and encapsulates the database session. Currently there is only an implementation for MongoDB access (MongoDBUserSession), but the abstraction via the IUserSession interface allows to add classes that offer access to Kafka or other databases. Classes that implement IUserSession are instantiated with a factory Method (UserSession()) which guarantees that the returned object represents a successfully logged in database session.

1.3.1 Class Diagram

Next we'll look at each class and method in detail

- Config properties file
The config file is stored alongside the built application .jar file and contains the path to the Kafka installation folder, the user name and password of a mongoDB account with the highest level of access and the name of the database.
- Initializer
Methods:
 - main
parameters: String of arguments from the console
returns: void
App entry point.
We load the config.properties file and use the path provided to start the zookeeper, kafka and mongodb services
- MongoConsumer
The Mongo Consumer, as the name implies, consumes all messages from all topics in the Kafka messaging system. Once a message is found it is passed along to the Mongo Client for further processing.
Variables
 - clientMediator
Type : MongoClientMediator
An instance of the Mongo Client Mediator, created with the credentials from the config file.
 Methods

- MongoConsumer constructor
parameters: user name and password of a mongoDB account with the highest level of access.
Initializes the MongoClient variable and calls listenForRecords();
- getAllTopics
parameters: none
returns: an array of strings containing all the available kafka Topics.
Asks the kafka server service which topics exists.
- listenForRecords
parameters: none
returns: void
This Method first calls getAllTopics and uses the array of topics to poll the kafka server for new messages.
If new messages are found then the messages are passed to the Mongo Mediator for adding them to the Database.
If no new messages are found for a topic notify the Mongo Mediator that the collection tied to the topic is ready for pre-processing.
- MongoClientMediator This object serves as a nexus between the users who want to get data out of the database and the consumer and dataProcessor who want to add data into the database. This class encapsulates the mongo client from the mongo API.

Variables

- client
type: MongoClient
An instance of the Mongo Client from the official java API.
- dataProc
A reference to the data processor class for this client.

Methods

- MongoClientMediator constructor
parameters: Username and password
Initializes the client variable, throws an error if the user is not found.
- addRecordToCollection
parameters: String representation of a record in json format
String name of the collection it should be added to.
returns: void
Converts the json string into a java object, then to a bson document and uses the mongoAPI to insert it into the database.
- addRecordsToCollection
parameters: String Array of records to be added to a collection
String name of the collection it should be added to.
returns: void
for each one of the members of the array call addRecordToCollection

- ProcessCollection
 - parameters: String, name of a collection
 - returns: void
 - signal the data processor to start the processing of a collection
 - getCollection
 - parameters: String, name of a collection
 - returns: String array containing all entries of the collection
 - getStartRecord
 - parameters: String, name of a collection
 - returns: the first entry of the collection as a String.
 - getEndRecord
 - parameters: String, name of a collection
 - returns: the last entry of the collection as a String.
 - getCollectionSize
 - parameters: String, name of a collection
 - returns: the number of entries in the collectoin as int
 - getRecordsInRange
 - parameters: String, name of the collection to query
 - String, key of the parameter used for filtering
 - String start and end ranges for the filtering
 - returns: String array containing all entries of the collection within that range
 - this Method is very general to allow for flexibility. For example by letting the key be, SourceIPaddresses, or a timeStamp.
 - getRecordsInRangeSize
 - parameters: String, name of the collection to query
 - String, key of the parameter used for filtering
 - String start and end ranges for the filtering
 - returns: number of elements matching the range as int
- Record

Every message that comes from kafka and needs to be added to the database has it's own Record class that inherit from this one.

Every single class that inherits needs to be able to, using reflection, convert itself into a Bson Document where every variable is a key Value pair of the name of the variable and it's associated value.

Variables

 - id
 - type: String

Methods

 - getAsDocument()
 - parameters: none
 - returns: A Document, containing every variable of any class inheriting from this

one.

This function checks for every variable, gets it's name and value as a string and adds it to the document that it eventually returns.

- PacketRecord

Inheriting from Record, this class contains the variables that match the json string obtained from kafka.

Variables

- id
type: String
this id is used for determining the ordering when saving to mongoDB, it's the offset of the message in the kafka messaging queue. inherited from Record
- client
type: String
- L2Protocol
type: String
- SourceMACAddress
type: String
- L4Protocol
type: String
- SourceIPAddress
type: String
- PacketSummary
type: String
- DestinationIPAddress
type: String
- Timestamp
type: String
- DestinationPort
type: String
- SourcePort
type: String
- DestinationMACAddress
type: String

Methods

- getters / setters
parameters: variable
returns: variable type
Each variable has it's getters and setter methods.

- AlarmRecord

Inheriting from Record, this class contains the variables that match the json string obtained from kafka.

Variables

- id
type: String
- AlarmID
type: String
- AlarmType
type: String
- AlarmOccurrenceTime
type: String
- AlarmCategory
type: String
- AlarmScore
type: String
- AlarmDescription
type: String
- PacketSummary
type: String

Methods

- getters / setters
parameters: variable
returns: variable type
Each variable has it's getters and setter methods.

- MiscRecord

Inheriting from Record, this class is used by the data processor as an 'in-between' state before saving to the database. As well as an extension point for adding more types of records into the database programatically in the future.

Refer to the data processor class for further data on the key value pairs.

Variables

- pairs
A Map of strings to Objects to store any 1 to many relationships

Methods

- getters / setters
parameters: none
returns: variable type
Each variable has it's getters and setter methods.

- DataProcessor

This class is a mediator for each one of our data aggregators used for extraciton of features from the raw data stored in mongoDB.

We might want to hve multiple data processors for chaining different aggregators together or to split up the work into mutiple threads. This is dependant on further performance testing.

Variables

- client
an instance of the associated mongoClient that requested the data aggregation
- aggregators
A Arraylist containing all the aggregators to be applied on a collection.

Methods

- getters / setters
- processData
parameters: variable
returns: variable type

- IAggregator

This interface is the building block for every aggregator to be applied to data

Variables Methods

- processData
parameters: Records array of the records to be processed

- FlowRatePerSecond

Implements IAggregator. This calculates, per port, the outgoing and ingoing connections.

A record processed by this aggregator is stored in a collection as follows:

Name of collection: collectionName_FlowratePerSec

structure of record as json:

```
{
  "date" : \{" date" " Unix_Timestamp  }
  rounded down to the second this record points to.
  Connections : [
    { Port: "portNumer", "InOut" : " In/Out ", count : "Number" }
    { Port: "portNumer", "InOut" : " In/Out ", count : "Number" }
    ...
  ]
```

] This array has an entry per port if the port communicated that second.

Precomputing this allows us to stream whenever the client needs the information for a specific node.

}

Methods

- processData
parameters: Records array of the records to be processed
specific implementation left to the classes implementing this interface

- NumberOfConnectionsPerNodePerSecond

Implements IAggregator. This calculates the outgoing and ingoing connections. A record processed by this aggregator is stored in a collection as follows:

Name of collection: collectionName_FlowratePerSec

structure of record as json:

```
{
  "date" : \{" date" " Unix_Timestamp  }
  rounded down to the second this record points to.
  Connections : [
    { Port: "portNumber", count : "Number" }
    { Port: "portNumber", count : "Number" }
    ...
  ]
```

This array has an entry per port if the port communicated that second.
Precomputing this allows us to stream whenever the client needs the information for a specific node.

}

Methods

- processData
parameters: Records array of the records to be processed

- Hub

This class implements the network handlers for the websocket connection to the client and access methods for a database connection.

Variables

- requestHandler
Type : ClientProtocolHandler
The strategy object we call for the actual parsing of the client requests.
- database
Type : IUserSession
The database we use during a user session.

Methods

- handleOpen
parameters: Session session - the current session
returns: void
Event handler for the start of websocket connection.

- handleClose
parameters: Session session - the current session
returns: void
Event handler for closing a connection.
 - handleMessage
parameters: String message - the message that we received from the client
Session session - the current session
returns: String - the response to be sent to the client
Event handler for receiving a message. The message is passed to the ClientProtocol-Handler.
 - handleError
parameters: Session session - the current session
Throwable t - the exception that occurred
returns: void
Event handler for errors/exceptions during communication.
- IUserSession
An IUserSession object encapsulates a data base session. On instantiation an IUserSession connects to a database using the given user id and password and uses this connection for all following data base access.
Methods
 - UserSession
parameters: String username - the user id to login with
String password - the password
returns: IUserSession
Factory method to instantiate a new UserSession and log in into the database using the given credentials.
 - getAvailableCollections
parameters: -
returns: String array with collection names
Returns an array with the names of the collections available to the current user.
 - getCollectionSize
parameters: String collection - the collection to query
returns: long - the number of records
Returns the number of records in the specified collection.
 - getCollection
parameters: String - name of a collection
returns: String array containing all entries of the collection
 - getRecordsInRange
parameters: String - name of the collection to query
String key - the parameter used for filtering
String start and end - range for the filtering
returns: String array containing all entries of the collection within the filter range

Returns an array containing all records of this collection for which the value of the specified key is in the range [start, end). The records will be in the same order as they are in the collection.

- `getRecordsInRangeSize`
parameters: String - name of the collection to query
String key - the parameter used for filtering
String start and end - range for the filtering
returns: number of elements matching the range as int
Returns the number of records in the specified collection for which the value of the specified key is within the range [start, end).

- **MongoDBUserSession**

Encapsulates a user session for a connection to a MongoDB database.

Methods

- `MongoDBUserSession` constructor
parameters: -
Private constructor to create a new MongoDB session.
- `UserSession`
parameters: String username - the user id to login with
String password - the password
returns: a new `MongoDBUserSession` object
Factory method to instantiate a new `MongoDBUserSession` and log in into the database using the given credentials.
- `getAvailableCollections`
parameters: -
returns: String array with collection names
Returns an array with the names of the collections available to the current user.
- `getCollectionSize`
parameters: String collection - the collection to query
returns: long - the number of records
Returns the number of records in the specified collection.
- `getCollection`
parameters: String - name of a collection
returns: String array containing all entries of the collection
- `getRecordsInRange`
parameters: String - name of the collection to query
String key - the parameter used for filtering
String start and end - range for the filtering
returns: String array containing all entries of the collection within the filter range
Returns an array containing all records of this collection for which the value of the specified key is in the range [start, end). The records will be in the same order as they are in the collection.

- getRecordsInRangeSize
parameters: String - name of the collection to query
String key - the parameter used for filtering
String start and end - range for the filtering
returns: number of elements matching the range as int
Returns the number of records in the specified collection for which the value of the specified key is within the range [start, end).

- ClientRequestHandler

This class handles client requests by parsing them, executing the requested action and producing responses. The requested actions are typically executed by calls to the database session object.

Methods

- handleRequest

parameters:

IUserSession dbSession - the current database session

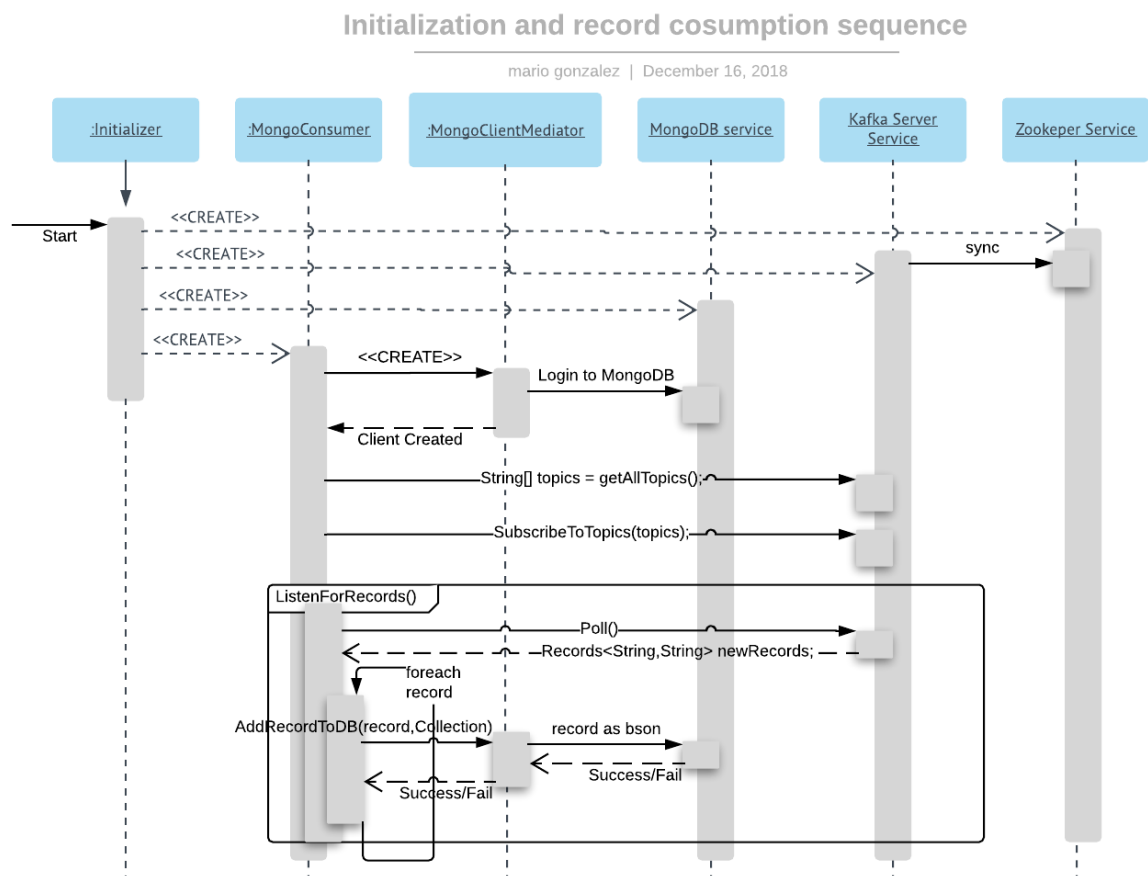
Session session - the current client session

String message - the client request to process

returns: String - the response to be sent to the client

Parse the message from the client, execute the requested action (typically a database query) and construct the response message.

1.3.2 Sequence Diagram



1.3.3 Activity Diagram

Consuming messages

{{lastModifiedBy}} | {{lastModifiedTime:MMMM d, yyyy}}

