Stemmarest

Documentation of the PSE2 Project 2015

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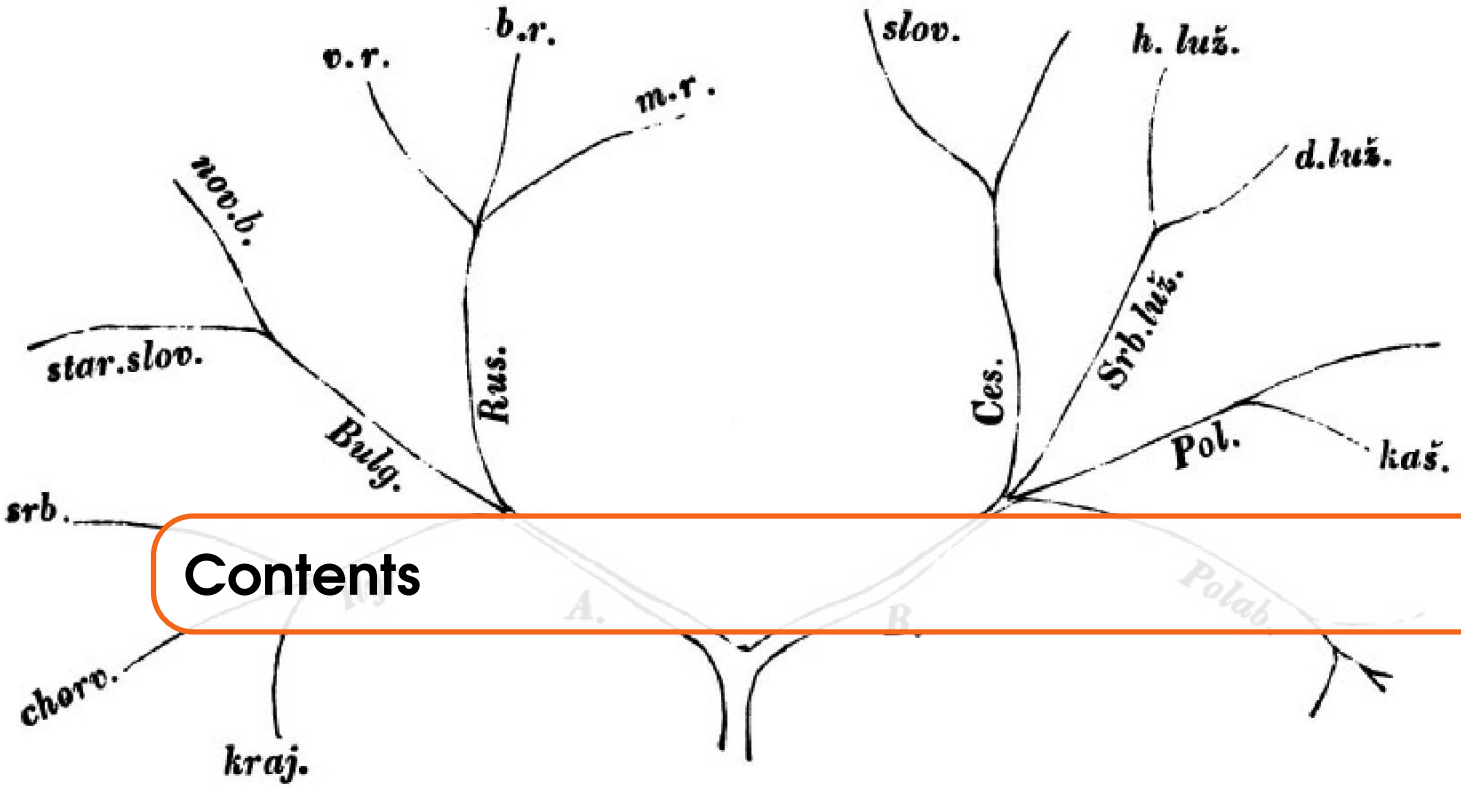

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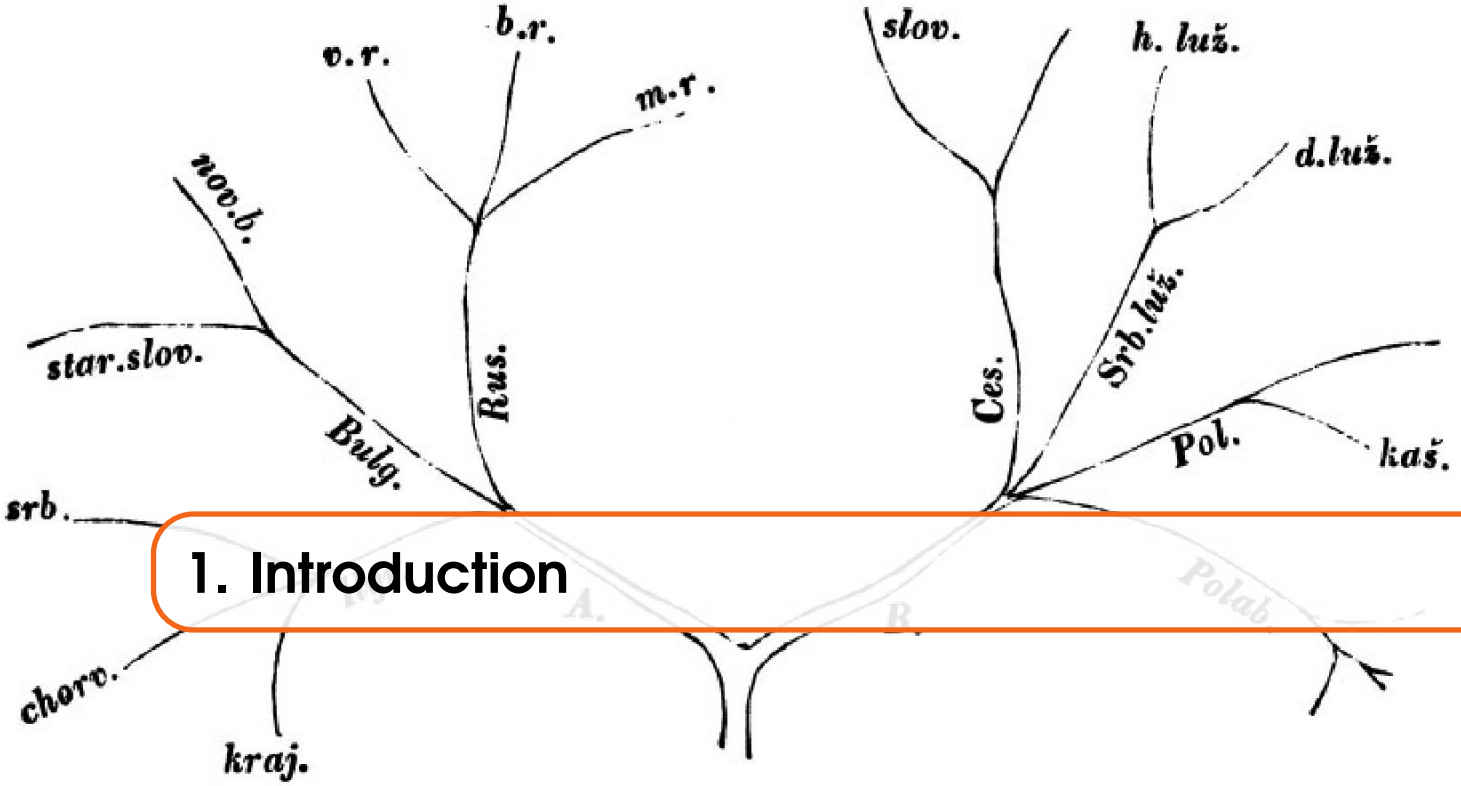

1. Introduction

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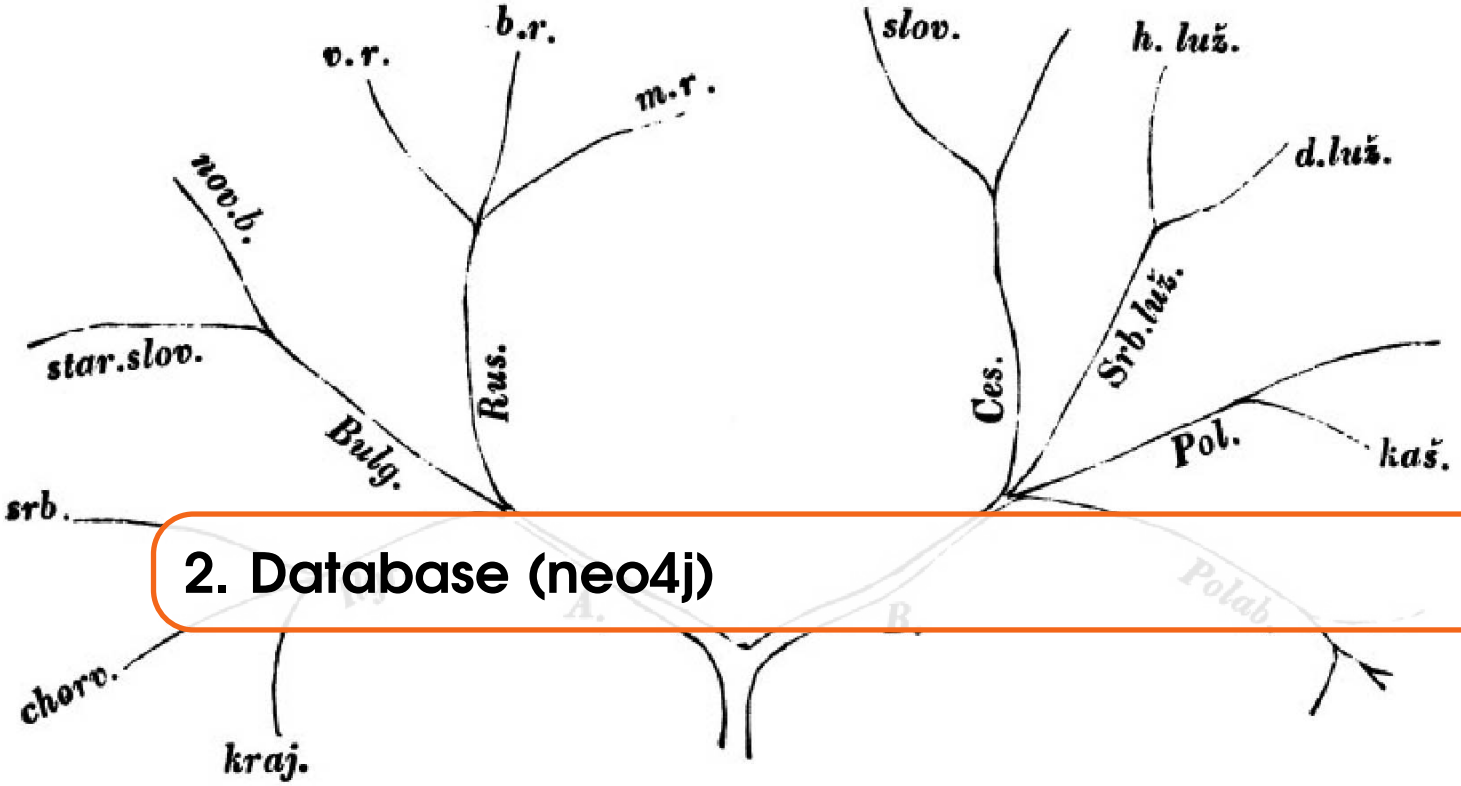


2. Database (neo4j)

In our project we used a graph database instead of a relational database.
This was due to the fact, that relational databases are much faster when it comes down to look for objects in a list that fulfill some constraints to other objects. Normally in a relational database you would use multiple joins to get your desired result. In the graph way it's much easier because you traverse the graph (previously mentioned as list) from top down using either breadth- or depth-first algorithm and look for a specific relation between two nodes (previously objects). In respect of that we save a lot of time traversing instead of writing complicated queries which run mostly slow.

Therefore we use Neo4J (Additional info can be found under http://neo4j.com/developer/graph-db-vs-rdbms/). Neo4J is a graph database that is capable of managing millions of nodes and relationships and returning or changing them within logarithmic or even constant time. That means that it won't make a big difference whether you use 10 nodes, or 1 million. You can find additional information on benchmarking in the related chapter of this documentation.

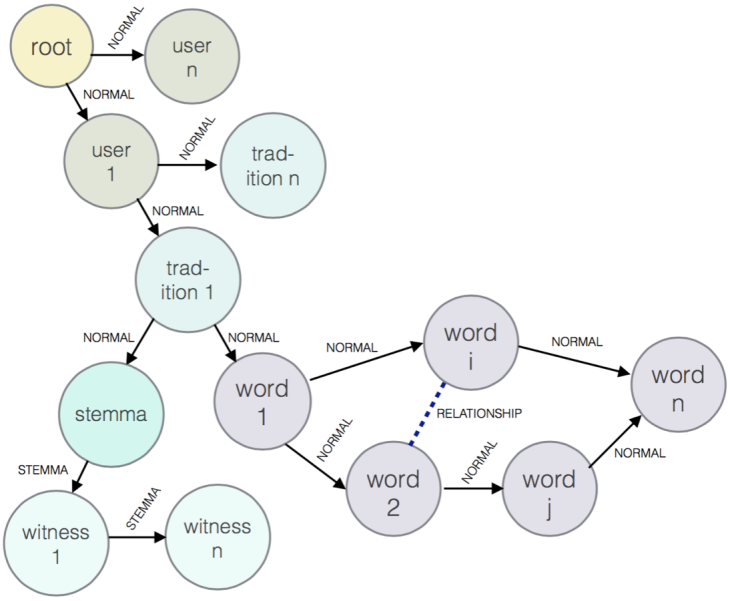
Our database is mainly one big graph. We use different Labels for Nodes and Relationships to increase the search speed.

In the database we use only a few labels:

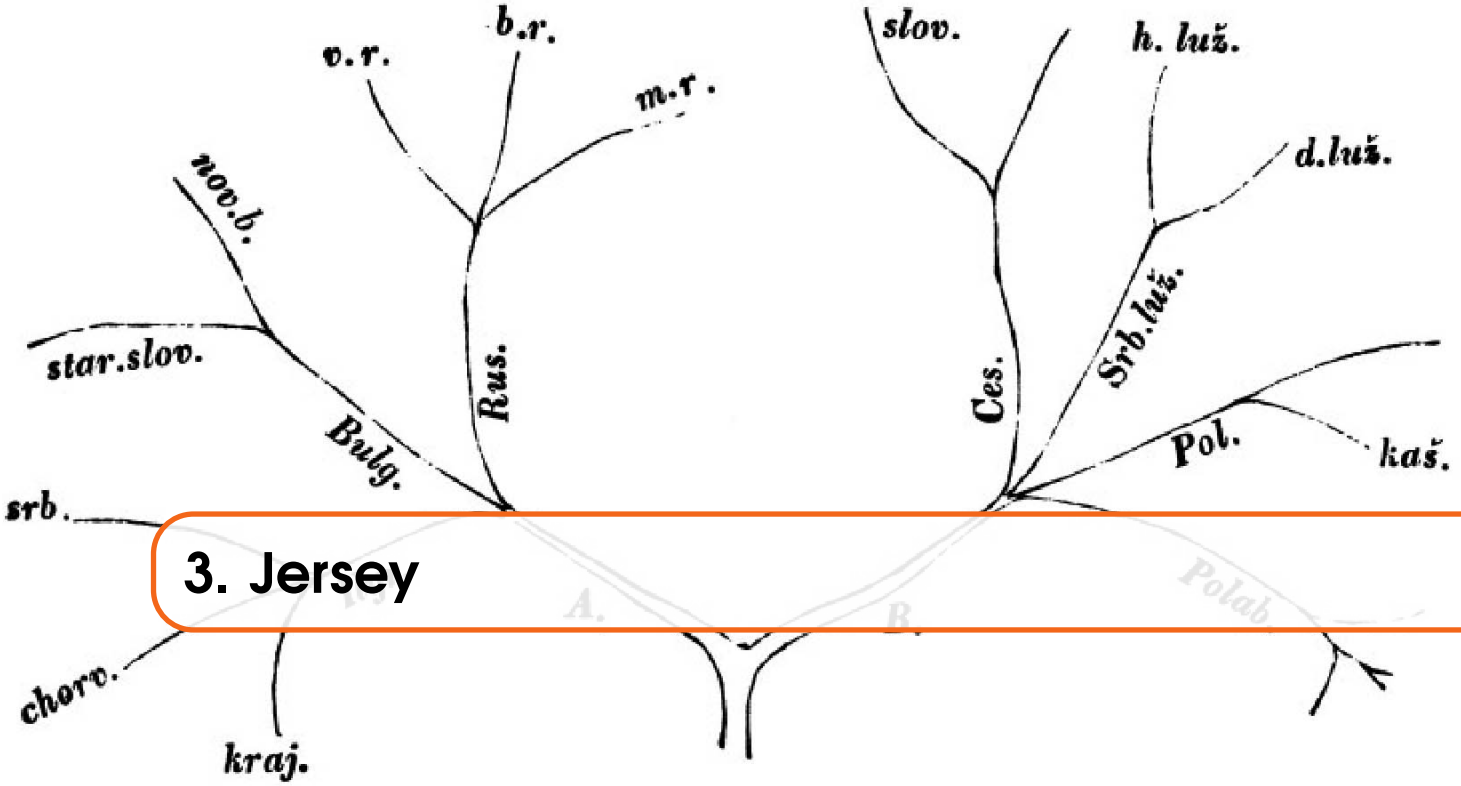
Nodes	**Relationships**
ROOT	RELATIONSHIP
STEMMA	STEMMA
WITNESS	NORMAL
TRADITION	
USER	
WORD	

Since each label is stored in another file, searching or traversing the graph is stunningly fast.

The database structure is as follows:



Neo4J is delivered with a powerful script language called cypher. It's the equivalent to SQL in relational databases. Cypher is a declarative graph query language that allows for expressive and efficient querying and updating of the graph store. Using cypher you can write simple queries that return nodes or traverse graphs. Cypher queries can be sent to the database and will then be interpreted and translated into an execution plan by the ExecutionEngine. This takes some time and therefore cypher can not compete with the native java traversal API.

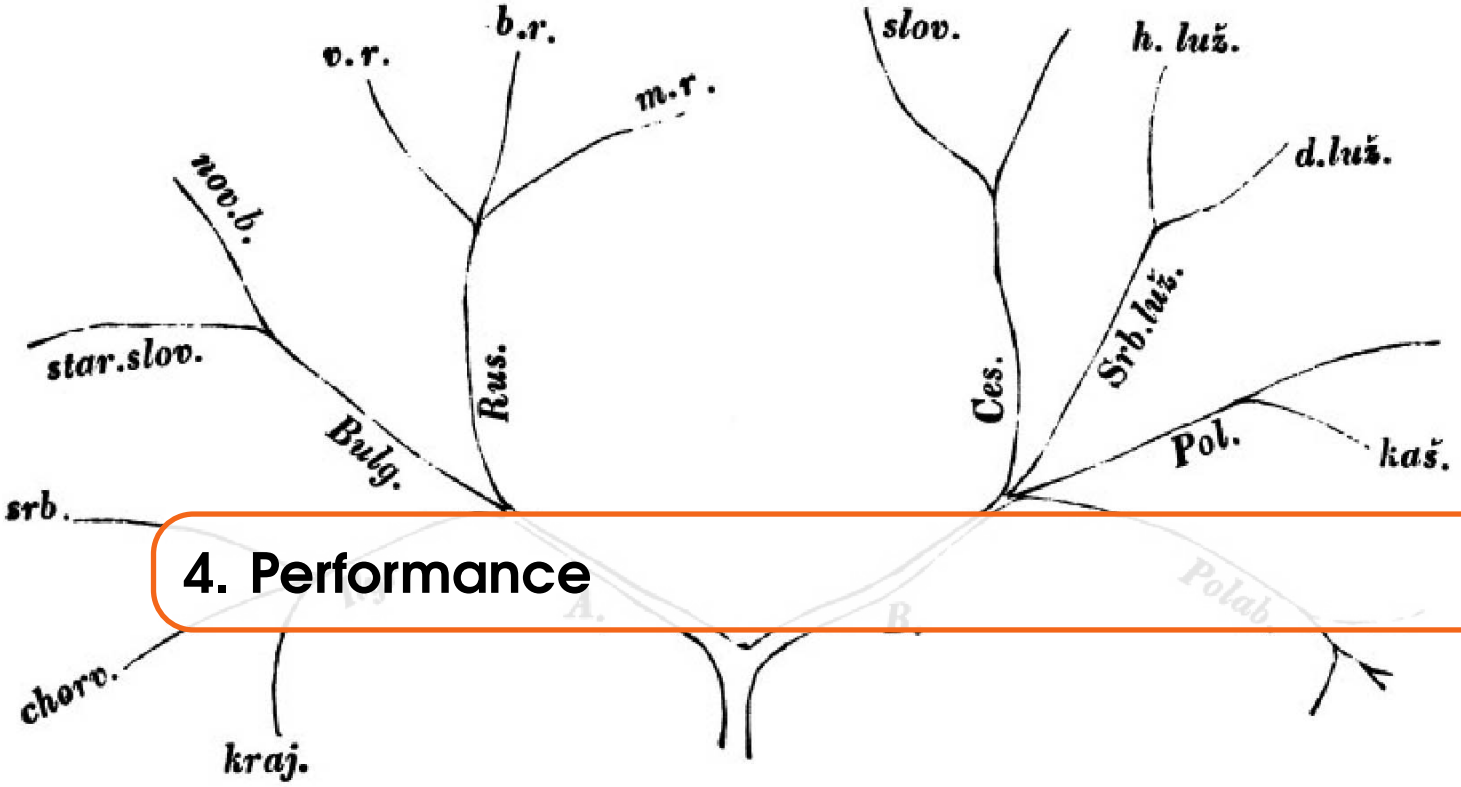


3. Jersey

In our project we built a REST-API for stemmaweb an online tool for textual scholars willing to explore their texts. For this REST-API we needed a simple and easy to use Java framework and chose Jersey.
Jersey is an open source framework for developing RESTful Web Services in Java that is built upon JAX-RS and serves as a JAX-RS Reference Implementation. It adds additional features and utilities in order to further simplify development of REST-APIs. It abstracts away low-level details of the client-server communication which made it more easy for us to concentrate on the actual implementation of the user stories. In our project it is deployed with GlassFish, a Java EE Application Server. Jersey can help support exposing the data in very different media types, including JSON, which we used very frequently.
Jersey uses Annotations which made it very easy to use for us.
Here as an example the method declaration of duplicateReading:

```
@POST
@Path("duplicatereading/fromtradition/{tradId}")
@Consumes(MediaType.APPLICATION_JSON)
@Produces(MediaType.APPLICATION_JSON)
public Response duplicateReading(DuplicateModel duplicateModel)
```

At the top the „POST“ annotation states the http method. Then the „Path“ annotation lets us set the url path with parameters in curly braces. Furthermore the method can „consume“ data, in this case JSON. The „DuplicateModel“ is passed with the call as a JSON object and then gets parsed in a POJO. Last but not least the method „produces“ a response, in this case also in JSON.



4. Performance

One of the main goals of the redesign is it to create a faster RESTful service. To assure the speed of the service some performance tests are done.

The aim of the performance tests is it to show that the response time of the service is limited and within a usable range. So the time to execute all operations for a certain request is measured. This contains the time to transmit the data over HTTP, the time to execute the internal algorithms and the time to access the database. All the Data are transmitted over the local loop interface, so the network speed is not measured.

To do the tests the database is populated by a random graph which contains several valid traditions on which the REST requests can be executed. Several tests with databases of a different size are done to show that the response time does not change with an increasing database size. (Actually there are several search by ID requests in the database which execute under O(log n) but as the database access time takes such a small percentage of the measurement scope this does not show up in the size of database expected for an operational database.)

In the following measurement series the dimension of the database size is tested. This tests show, that the RESTful service response time is not influenced by the size of the database in a significant way. This is related to the use of the Graphdatabase which allows to work on a subgraph without filtering the whole database.

R The implementation of stemma rest uses some search node by id methods which search over the complete database but those are in $O(logn)$ and are not seen in the noise of the other operations. In a much bigger Database those methods will slow down the REST requests. But it is not expected that the database will grow that big, that this operations will have any impact.

The previous measurement series tested the dimension of the database size and could show that the response time is almost independent of it for the expected database size of something between

Figure 4.1: Database with 1000 nodes, working tradition with 100 nodes

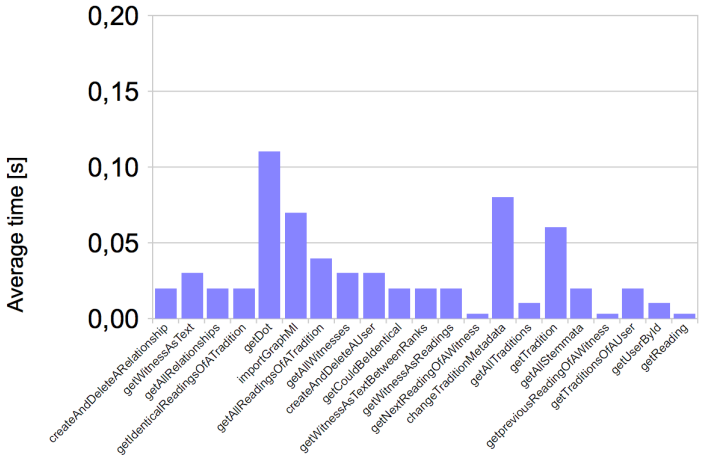


Figure 4.2: Database with 100000 nodes, working tradition with 100 nodes

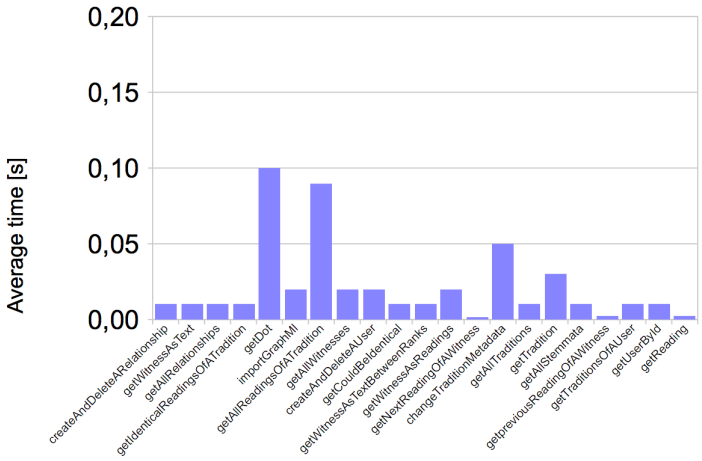
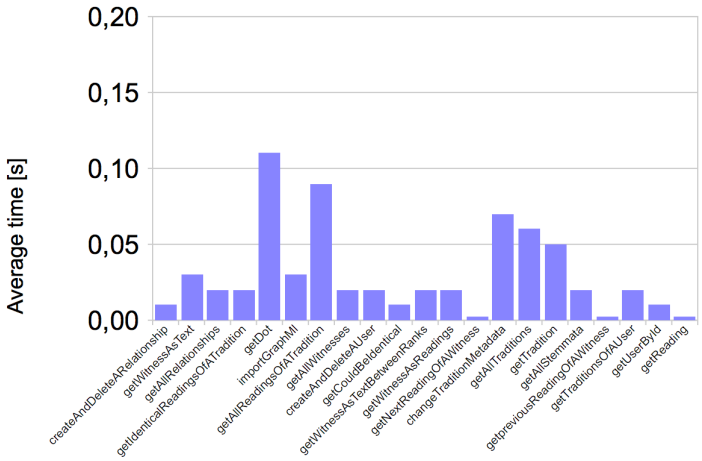


Figure 4.3: Database with 1000000 nodes, working tradition with 100 nodes



1000 and 1 Million Nodes (Readings). This independence results out of the fact, that each Tradition can be selected as a subgraph and the algorithms only have a subset of the whole database to search

trough. It is obviously that those algorithms are not independent of the tradition size as the working subset grows with a bigger tradition. Most of the algorithms to work on a tradition are in $O(logn)$ but there are also some export and import functions which have to handle each node and relation of the tradition and run in $O(n)$.

In the following test series the dimension of the tradition size is varied. This measurement

Figure 4.4: Database with 10000 nodes, working tradition with 1000 nodes

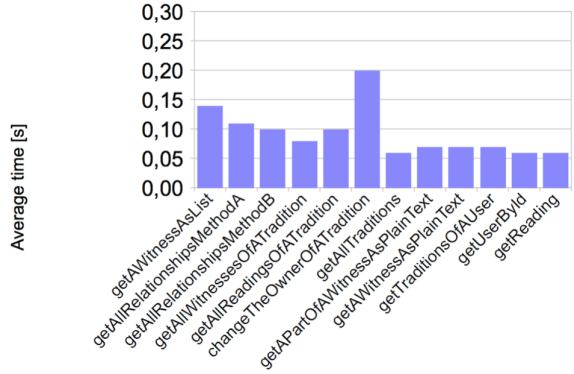
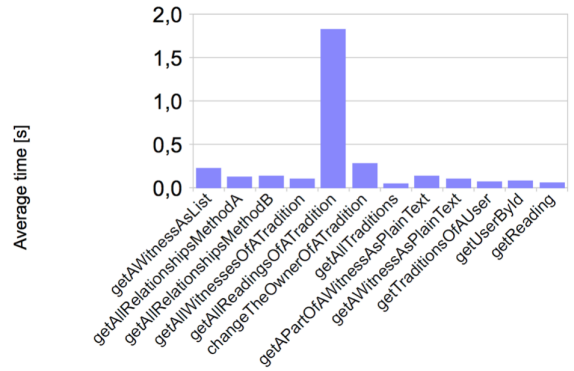


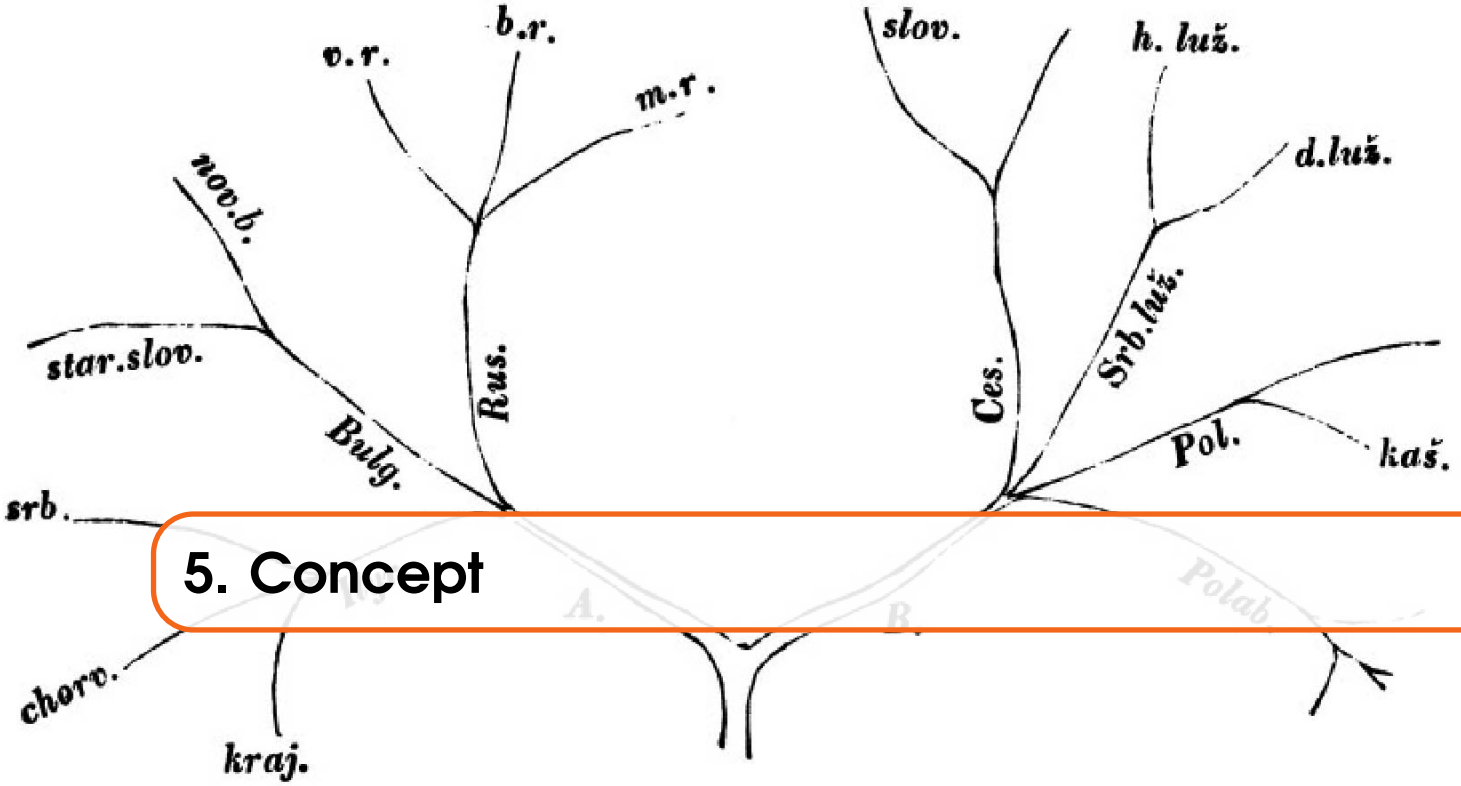
Figure 4.5: Database with 10000 nodes, working tradition with 10000 nodes



shows that the execution time depend on the size of the working tradition. In this test result the getAllReadingsFromATradition each reading of the tradition is parsed to a JSON Object and all are returned as an List. The parsing of those nodes executes in O(n) and the downloading of the JSON file takes also its time. As larger traditions are not expected the execution time of those methods is in the accepted range.

II

Testing



5. Concept

This chapter describes the test-concept of the Digital Humanities PSE2 Project. The testing is used to assure the quality of the project and for test driven development. All tests are written in a manner they don't have any impact on the architecture of the project.

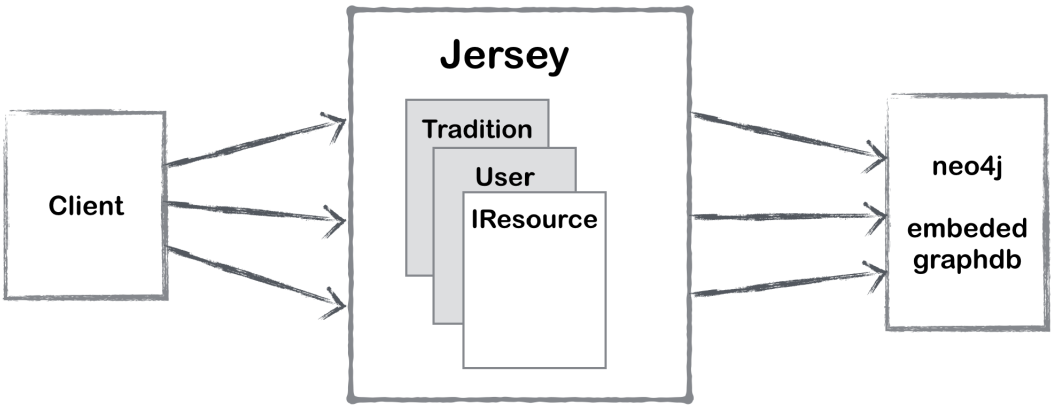
Integration Tests

Every user story is tested by an integration Test. The integration tests assures the quality of the project. The technique of integration tests is described in the Integration test chapter.

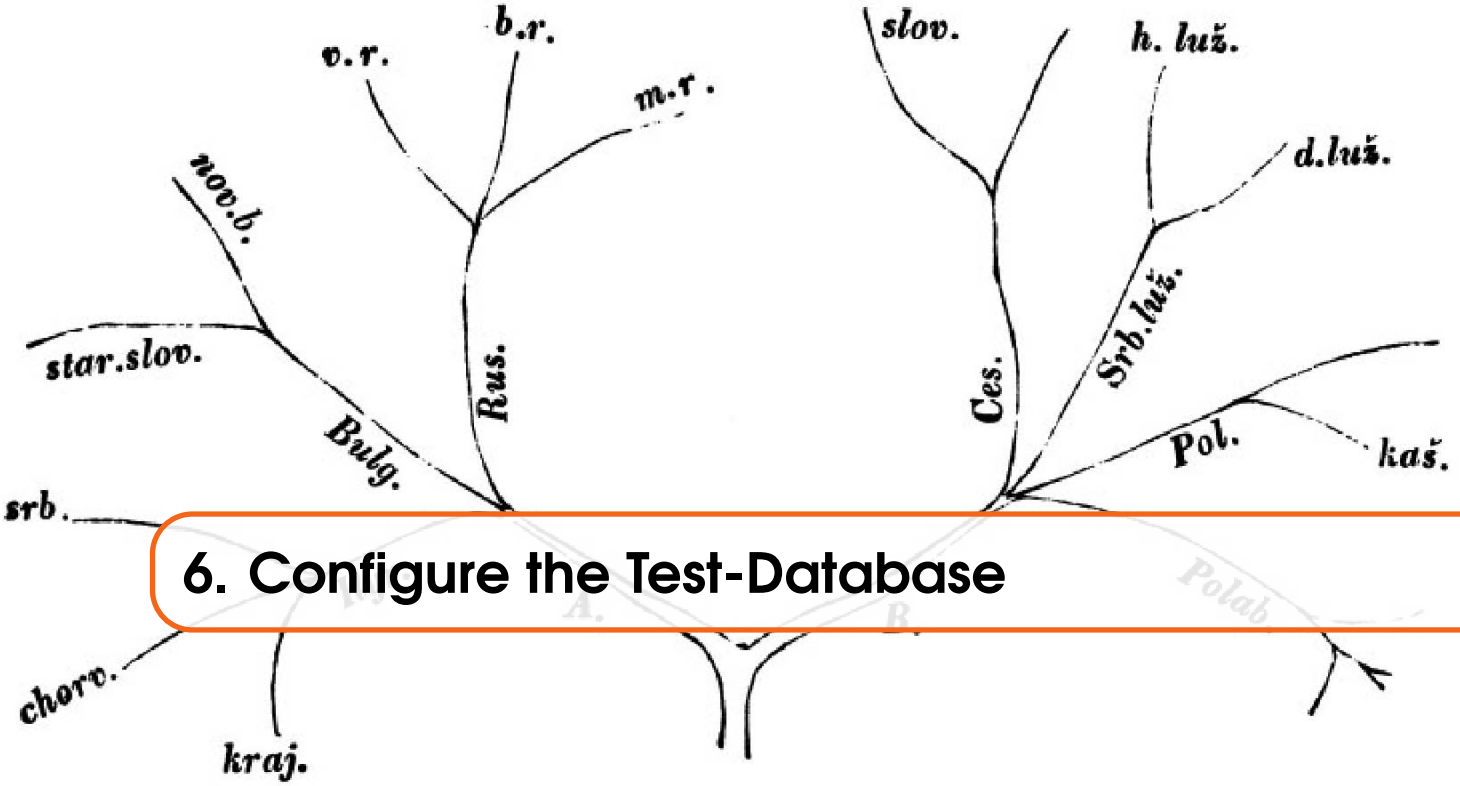
Unit Tests

Unit tests are used for test driven development and are defined by the developer. They are only for the development process and are not referenced in quality audits.

Jersey Overview



In the productive system for every REST call jersey is instantiating the requested resource and providing the service. Each resource object has its own database service, which is closed after each call. In production a embedded neo4j GraphDatabase is used. To achieve a minimal invasive test system the productive database needs to be replaced with a test database. To change the database with minimal test related code in the project, the GraphDatabaseServiceProvider can be configured to return an impermanent Database.



6. Configure the Test-Database

In this Project the GraphDatabaseService is a Singleton Object provided by the GraphDatabaseServiceProvider. To use a Testdatabase in the Tests the following steps have to be done. A Claswide GraphDatabaseService object db has to be registered.

```
GraphDatabaseService db;
```

In the @Before method the singleton GraphDatabaseService provided by the GraphDatabaseServiceProvider has to be overwritten by the following line:

```
GraphDatabaseServiceProvider.setImpermanentDatabase();
```

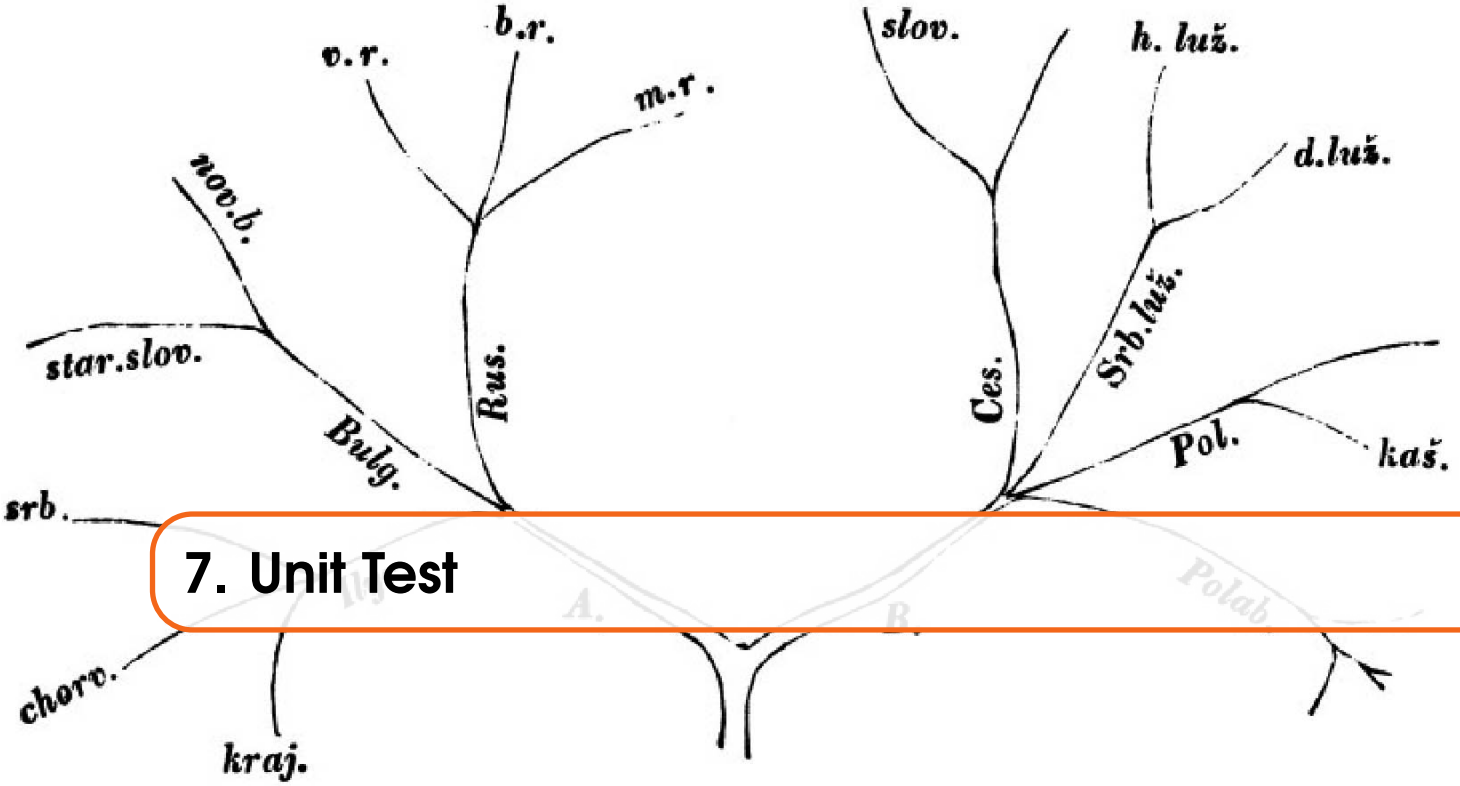
Later the db object can be initialized by:

```
db = new GraphDatabaseServiceProvider().getDatabase();
```

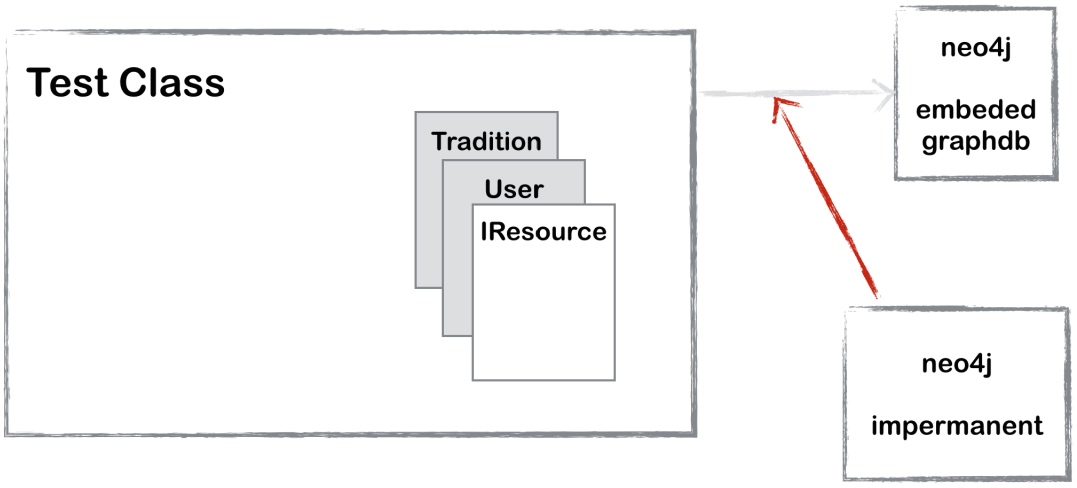
In the @After method the database has to be closed

```
db.shutdown();
```

With this configuration the impermanent Testdatabase of Neo4j is used during the tests.



7. Unit Test

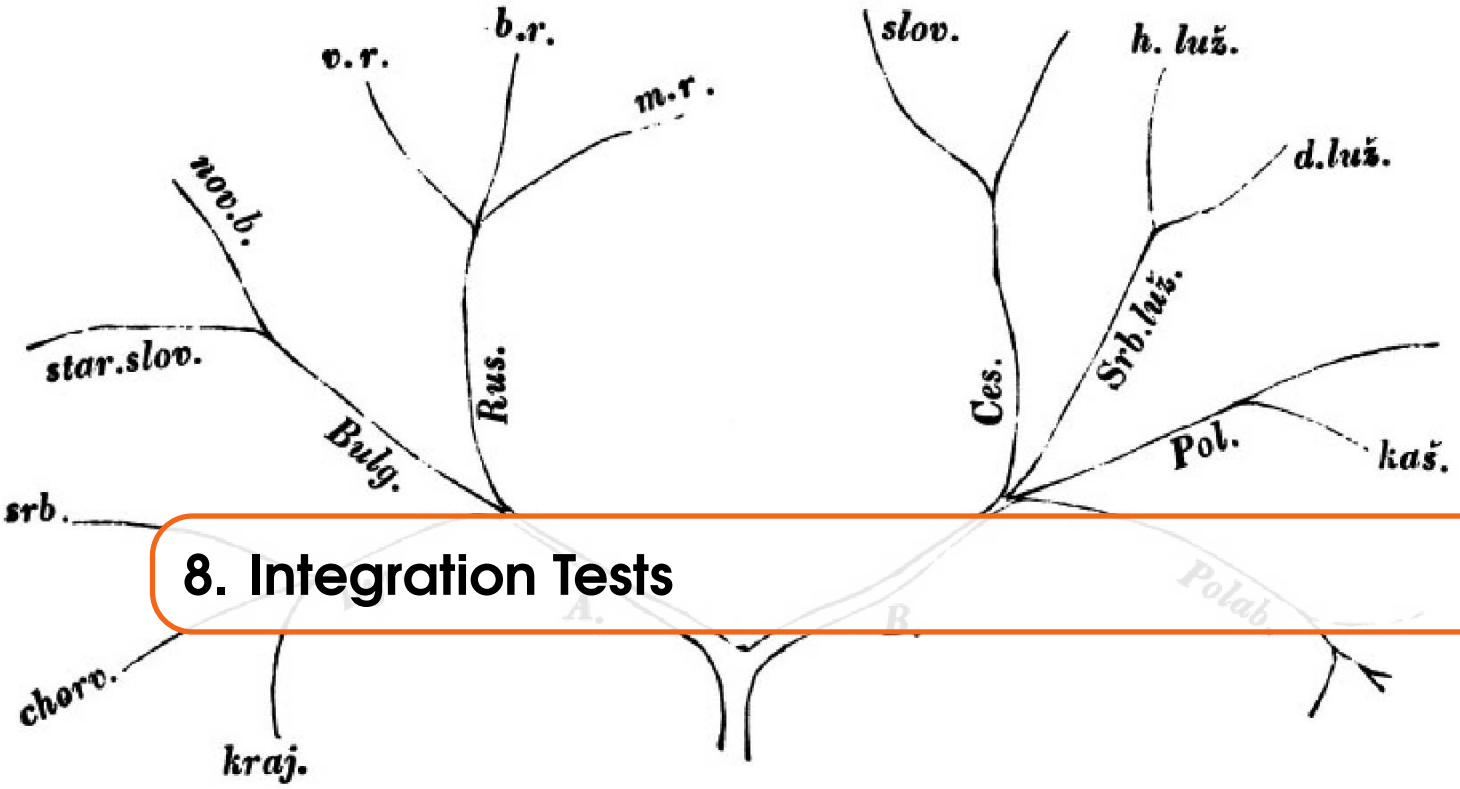


For Unit Tests the methods of the resource are called directly.

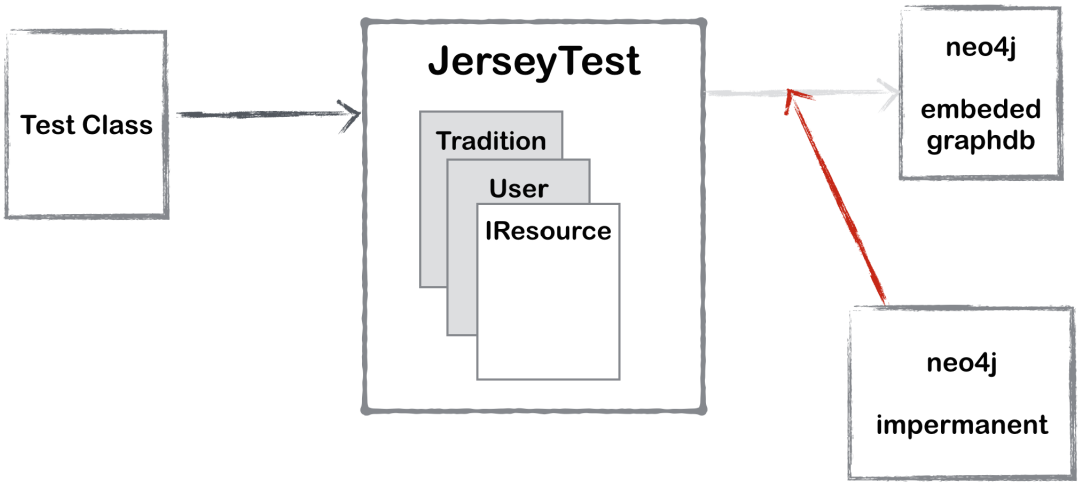
```
@Test
public void SimpleTest(){
  String actualResponse = userResource.getIt();
  assertEquals(actualResponse, "User!");
}
```

Example

https://github.com/tohotforice/PSE2_DH/blob/e364fcb0c164981281c5799a6bf9f9f9ea5eb503/stemmarest/src/test/java/net/stemmaweb/stemmaserver/UserUnitTest.java



8. Integration Tests



To inject objects into a resource it is mandatory that the resource is created statically at the place the injection is done. This is not possible when the resources are instantiated when a REST call occurs. To solve this JerseyTestServerFactory creates a server where already instantiated resources can be registered. To start a JerseyTestServer a global JerseyTest has to be created.

```
private JerseyTest jerseyTest;
```

The JerseyTestServerFactory creates a JerseyTest with already instantiated resources. This is necessary to inject the mock objects. Multiple resources can be added by chaining .addResource(..).addResource()

```
jerseyTest = JerseyTestServerFactory.newJerseyTestServer()
        .addResource(userResource).create();
jerseyTest.setUp();
```

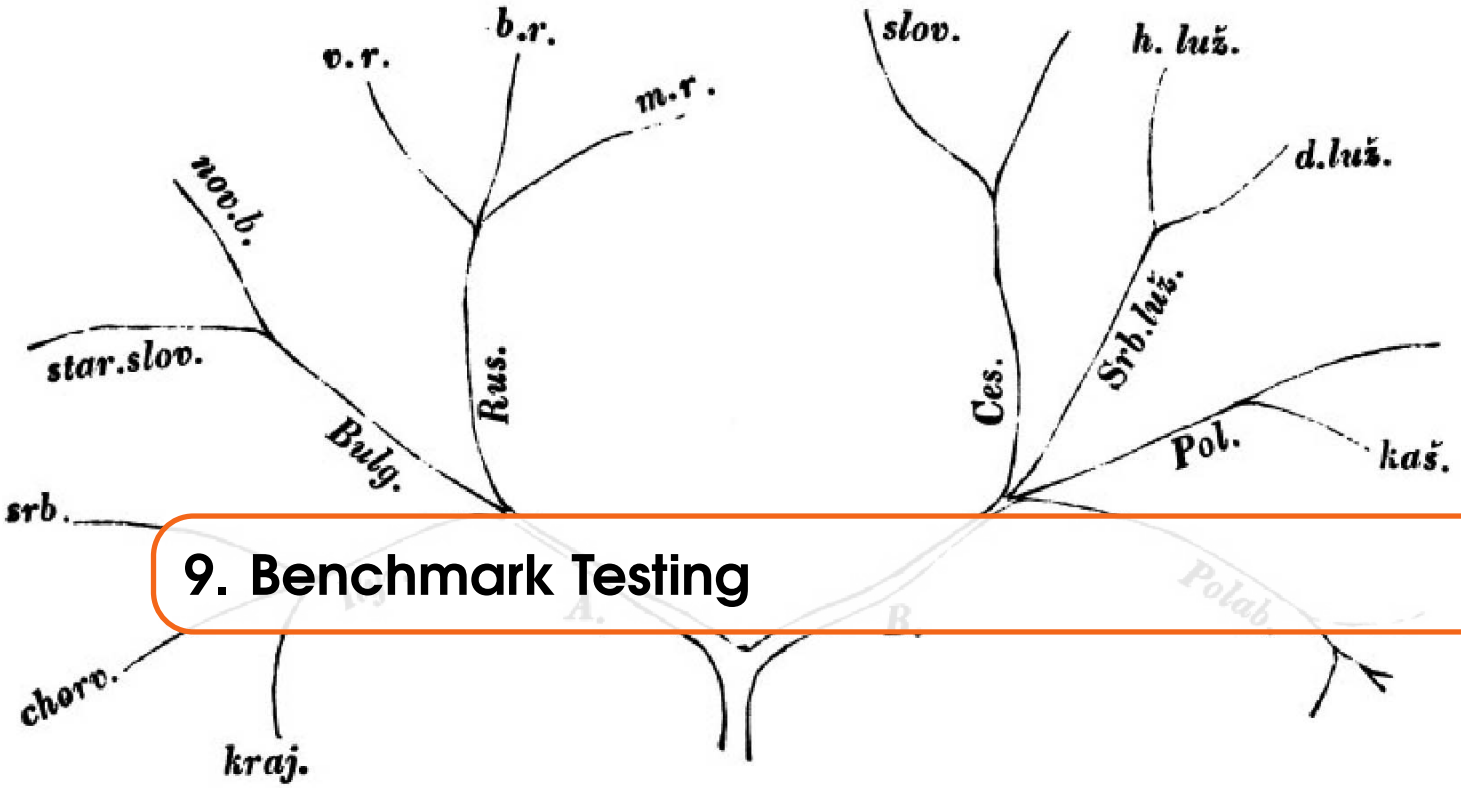
The test is done by calling a webresource of jerseyTest

```
@Test
```

```
public void SimpleTest(){
  String actualResponse = jerseyTest.resource()
      .path("/user").get(String.class);
  assertEquals(actualResponse, "User!");
}
```

Example

https://github.com/tohotforice/PSE2_DH/blob/e364fcb0c164981281c5799a6bf9f9f9ea5eb503/stemmarest/src/test/java/net/stemmaweb/stemmaserver/UserTest.java



9. Benchmark Testing

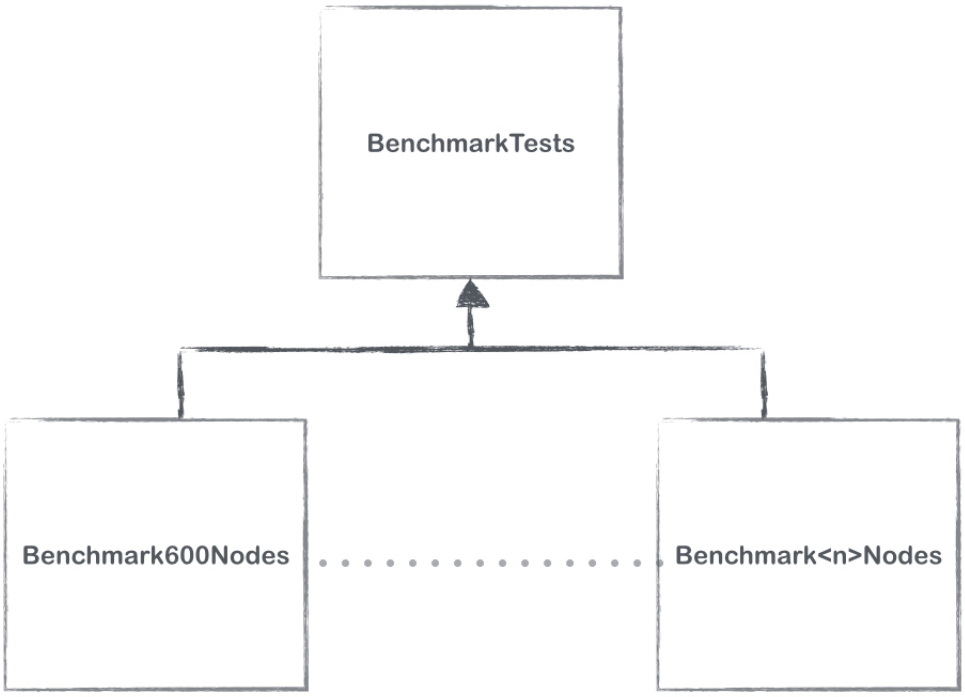
A main goal of the PSE2 stemmarest project is a good performance compared to the previous RESTful service. To measure the performance benchmark testing is needed. A benchmark test basically calls the RESTful service multiple times and measure the response time. To achieve this *com.carrotsearch.junitbenchmarks* a handy JUnit benchmark test suite is used. This JUnitbenchmarks measure the time which is used to execute a test and can generate visual representations of the measurement.
For the benchmark testing it is of interest to have a variety of different databases. Those databases should differ in their size from small to very huge. This allows to measure the algorithms in extreme situations. To generate valid graphs only limited by diskspace the class *RandomGraphGenerator* can be used. By calling the static method role a graph is generated according to the parameters.

R Please note that the response time highly depends on the hardware the tests are running on and the actual state of Javas virtual machine.

To reduce the influence of the virtual machine before the measurements 5 warm-up calls are done to bring the virtual machine to live. The hardware which was used for testing is represented in the report.

Setup

All the classes related to the Benchmark Tests can be found in the package *net.stemmaweb.stemmaserver.benachmarktests*. The class BenchmarkTests contains all Tests. The classes Benchmark<n>Nodes contain the database generation. Here is configured how many nodes the database has. This are also the classes which are run with JUnit test. BenchmarkTests cant be run as a JUnit test as it is a abstract class. s



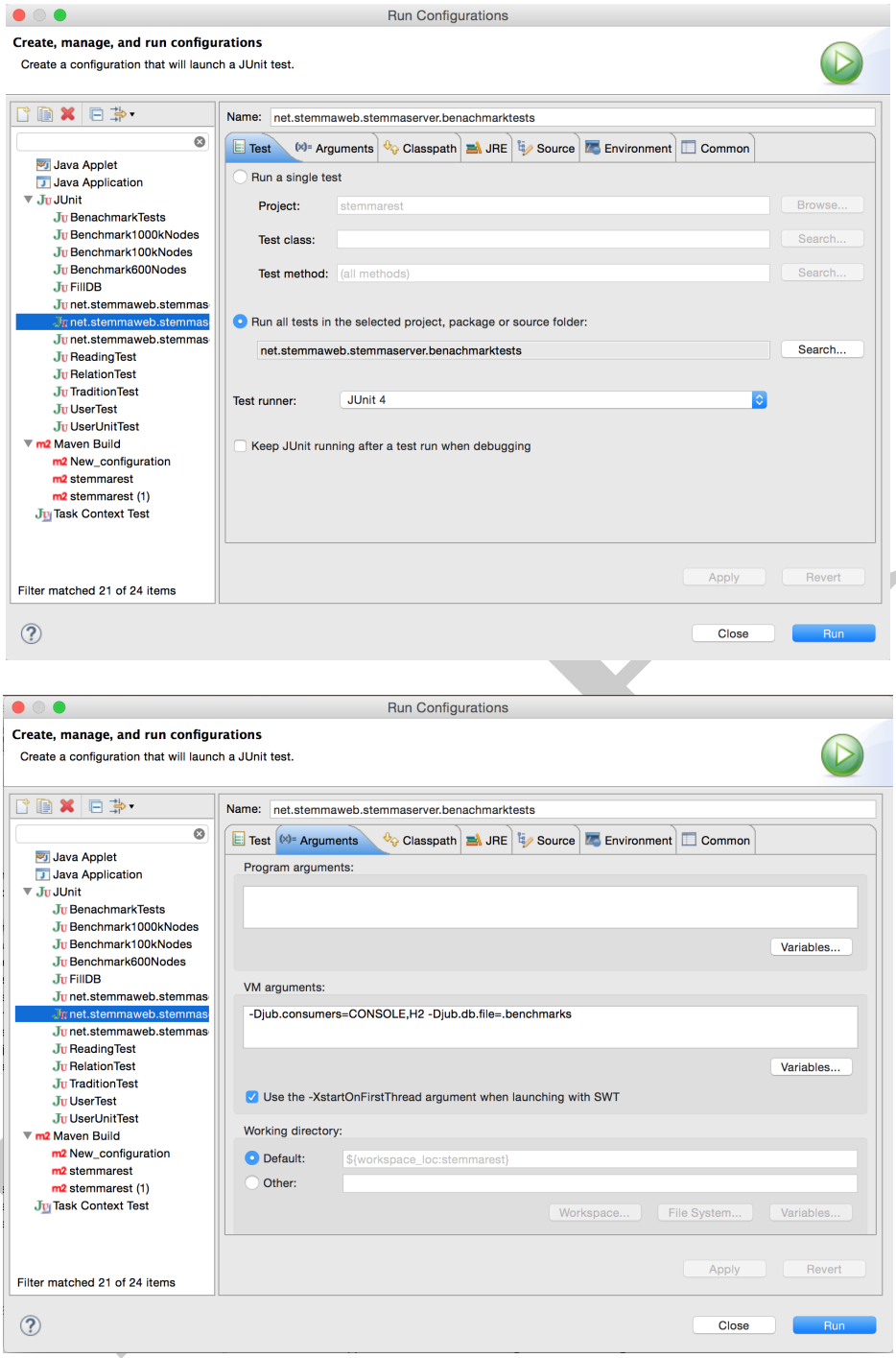
Tests are simply implemented in the BenchmarkTests class with the @Test annotation. It is best practice only to implement the restcall in this method and only test if Response.Status is OK. This assures that as less as possible overhead time is measured. And the integration- and JUnit tests should be done on a other place.

R JUnitBenchmarks measures the time to execute (@Before, @Test, @After). Heavy operations which should not be measured can be done in @BeforeClass and @AfterClass.

To create a new database test-environment copy the class Benchmark600Nodes and rename it to the count of Nodes that should be inserted. In the class itself only two small adjustments need to be done. First change the name of the report file *@BenchmarkMethodChart(filePrefix = "benchmark/benchmark-600Nodes").* Second adjust the properties of the database which should be generated *rgg.role(db, 2, 1, 3, 100);*. role(databaseService, cardinalityOfUsers, cardinalityOfTraditionsPerUser, cardinalityOfWitnessesPerTradition, degreeOfTheTraditionGraphs)

Run Benchmarktests

The Benchmarktests can be run as every JUnit test. But to generate the report an argument needs to be passed by. Create a JUnit Test as follows:

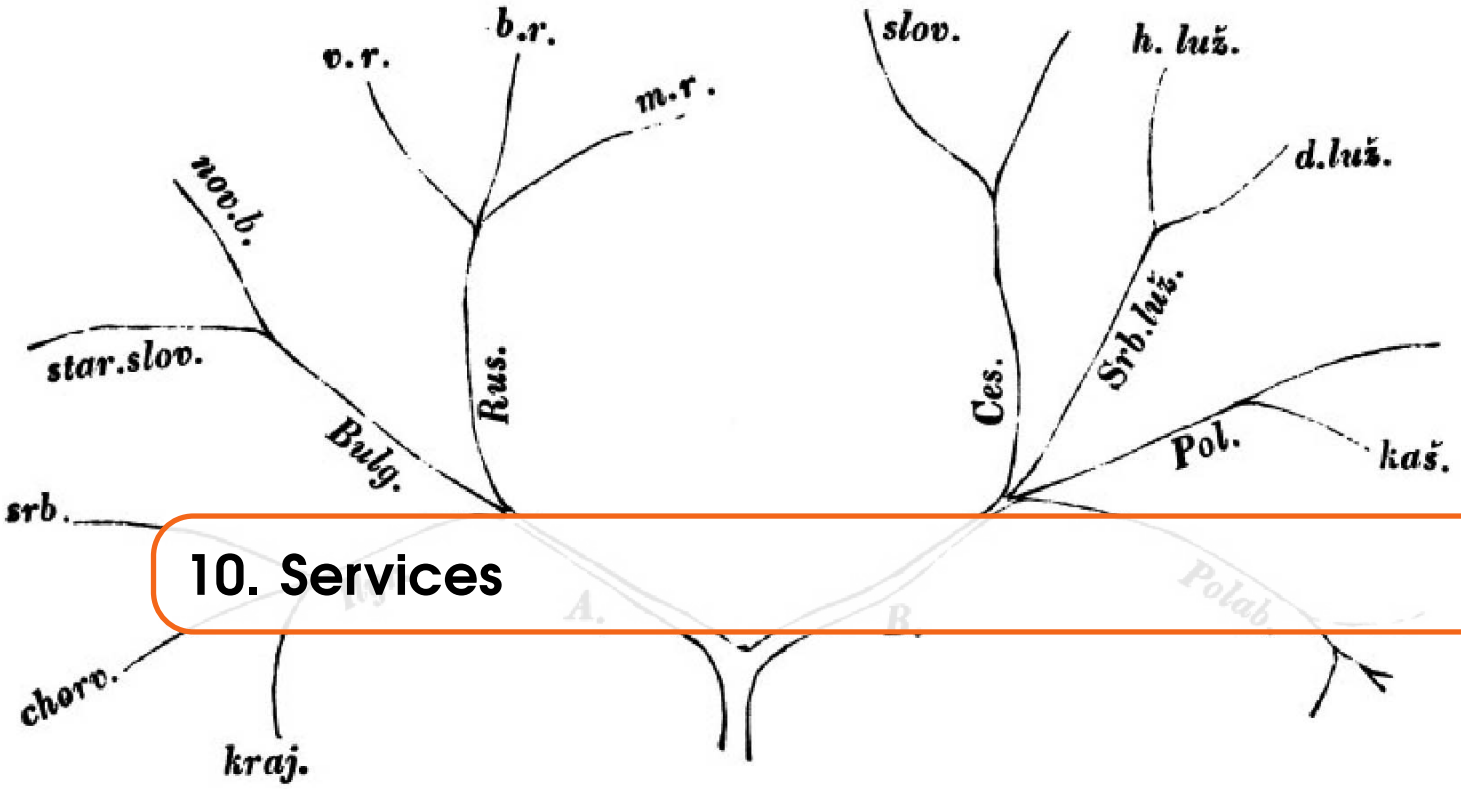


On the tab Arguments *-Djub.consumers=CONSOLE,H2 -Djub.db.file=.benchmarks* has to be inserted into the VM Arguments input. After the test can be run as usual. After the test execution the reports are stored under *benchmark/*.

R The execution of the tests will take some time because of the generation of huge graphs. Its recommended not to use the computer during this tests.

III

RESTful API



10. Services

10.1 Baseresource:

http://localhost:8080/

10.2 /stemma

Method Name: getAllStemmata
Gets a list of all Stemmata available, as dot format

`GET` /getallstemmata/fromtradition/{tradId}

Response list of stemmata as dot

Parameter tradId as string

Method Name: setStemma
Puts the Stemma of a DOT file in the database

`POST` /newstemma/intradition/{tradId}

Request as application/json

Response stemma as dot

Parameter tradId as string

Method Name: reorientStemma
Reorients a stemma tree with a given new root node

`POST` /reorientstemma/fromtradition/{tradId}/withtitle/{stemmaTitle}/withnewrootnode/{nodeId}

Response stemma as dot

Parameter tradId as string

Parameter stemmaTitle as string

Parameter nodeId as string

Method Name: getStemma
Returns JSON string with a Stemma of a tradition in DOT format

GET /getstemma/fromtradition/{tradId}/withtitle/{stemmaTitle}

Response stemma as dot

Parameter tradId as string

Parameter stemmaTitle as string

10.3 /relation

Method Name: delete
Remove all relationships, as it is done in https://github.com/tla/stemmaweb/blob/master/lib/stemmaweb/Controller/Relat line 271) in Relationships of type RELATIONSHIP between the two nodes.

POST /deleterelationship/fromtradition/{tradId}

Request relationshipModel as application/json

Response as text/plain: HTTP Response 404 when no node was found, 200 When relationships where removed

Parameter tradId as string

Method Name: create
Creates a new relationship between the two nodes specified.

POST /createrelationship

Request relationshipModel as application/json

Response as application/json

Method Name: getAllRelationships
Get a list of all relationships from a given tradition.

GET /getallrelationships/fromtradition/{tradId}

Response list of relationshipModel as application/json

Parameter tradId as string

Method Name: deleteById
Removes a relationship by ID.

DELETE /deleterelationshipbyid/withrelationship/{relationshipId}

Response relationshipModel as application/json

Parameter relationshipId as string

10.4 /tradition

Method Name: getAllRelationships
Gets a list of all relationships of a tradition with the given id.

GET /getallrelationships/fromtradition/{tradId}

Response list of relationshipModel as application/json

Parameter tradId as string

Method Name: changeTraditionMetadata
Changes the metadata of the tradition.

POST /changemetadata/fromtradition/{tradId}

Request traditionModel as application/json

Response traditionModel as application/json

Parameter tradId as string

Method Name: getAllTraditions
Gets a list of all the complete traditions in the database.

GET /getalltraditions

Response list of traditionModels as application/json

Method Name: getAllWitnesses
Gets a list of all the witnesses of a tradition with the given id.

GET /getallwitnesses/fromtradition/{tradId}

Response list of witnessModels as application/json

Parameter tradId as string

Method Name: getTradition
Returns GraphML file from specified tradition owned by user

GET /gettradition/withid/{tradId}

Response as application/json: XML data

Parameter tradId as string

Method Name: deleteTraditionById
Removes a complete tradition

`DELETE /deletetradition/withid/{tradId}`

Response as text/plain: http response

Parameter tradId as string

Method Name: importGraphMl
Imports a tradition by given GraphML file and meta data

`POST //newtraditionwithgraphml`

Request as multipart/form-data

Response the id of the imported tradition as text/plain

Method Name: getDot
Returns DOT file from specified tradition owned by user

`GET /getdot/fromtradition/{tradId}`

Response as application/json: XML data

Parameter tradId as string

10.5 /reading

Method Name: changeReadingProperties
Changes properties of a reading according to its keys

`POST /changeproperties/ofreading/{readId}`

Request as application/json

Response readingModel as application/json

Parameter readId as long

Method Name: getReading
Returns a single reading by global neo4j id

`GET /getreading/withreadingid/{readId}`

Response readingModel as application/json

Parameter readId as long

Method Name: duplicateReading
Duplicates a reading in a specific tradition. Opposite of merge

POST /duplicatereading

Request duplicateModel as application/json

Response GraphModel as application/json

Method Name: mergeReadings
Merges two readings into one single reading in a specific tradition. Opposite of duplicate

POST /mergereadings/first/{firstReadId}/second/{secondReadId}

Response as application/json: Status.OK on success or Status.INTERNAL_SERVER_ERROR with a detailed message.

Parameter secondReadId as long

Parameter firstReadId as long

Method Name: splitReading
Splits up a single reading into several ones in a specific tradition. Opposite of compress

POST /splitreading/ofreading/{readId}/withsplitindex/{splitIndex}

Request as text/plain

Response GraphModel as application/json

Parameter readId as long

Parameter splitIndex as int

Method Name: getNextReadingInWitness
gets the next readings from a given readings in the same witness

GET /getnextreading/fromwitness/{witnessId}/ofreading/{readId}

Response readingModel as application/json

Parameter readId as long

Parameter witnessId as string

Method Name: getPreviousReadingInWitness
gets the previous readings from a given readings in the same witness

GET /getpreviousreading/fromwitness/{witnessId}/ofreading/{readId}

Response readingModel as application/json

Parameter readId as long

Parameter witnessId as string

Method Name: getAllReadings
Returns a list of all readings in a tradition

GET /getallreadings/fromtradition/{tradId}

Response list of readingModels as application/json

Parameter tradId as string

Method Name: getIdenticalReadings
Get all readings which have the same text and the same rank between given ranks

GET /getidenticalreadings/fromtradition/{tradId}/fromstartrank/{startRank}/toendrank/{endRank}

Response list of list of readingModels as application/json

Parameter endRank as long

Parameter tradId as string

Parameter startRank as long

Method Name: getCouldBeIdenticalReadings
Returns a list of a list of readingModels with could be one the same rank without problems

GET /couldbeidenticalreadings/fromtradition/{tradId}/fromstartrank/{startRank}/toendrank/{endRank}

Response list of readingModels as application/json

Parameter endRank as long

Parameter tradId as string

Parameter startRank as long

Method Name: compressReadings
Compress two readings into one. Texts will be concatenated together (with or without a space or extra text. The reading with the lower rank will be given first. Opposite of split

POST /compressreadings/read1id/{read1Id}/read2id/{read2Id}/concatenate/{con}

Request as text/plain

Response as application/json: status.ok if compress was successful. Status.INTERNAL_SERVER_ERROR with a detailed message if not concatenated

Parameter read1Id as long

Parameter read2Id as long

Parameter con as string

10.6 /witness

Method Name: getWitnessAsText
finds a witness in the database and returns it as a string

GET /gettext/fromtradition/{tradId}/ofwitness/{witnessId}

Response a witness as a string

Parameter tradId as string

Parameter witnessId as string

Method Name: getWitnessAsTextBetweenRanks
find a requested witness in the data base and return it as a string according to define start and end readings (including the readings in those ranks). if end-rank is too high or start-rank too low will return till the end/from the start of the witness

GET /gettext/fromtradition/{tradId}/ofwitness/{witnessId}/fromstartrank/{startRank}/toendrank/{endRank}

Response a witness as a string

Parameter endRank as string

Parameter tradId as string

Parameter startRank as string

Parameter witnessId as string

Method Name: getWitnessAsReadings
finds a witness in the database and returns it as a list of readings

GET /getreadinglist/fromtradition/{tradId}/ofwitness/{witnessId}

Response list of readingModels as application/json

Parameter tradId as string

Parameter witnessId as string

10.7 /user

Method Name: create
Creates a user based on the parameters submitted in JSON.

POST /createuser

Request userModel as application/json

Response userModel as application/json

Method Name: getUserById
Gets a user by the id.

`GET` /getuser/withid/{userId}

Response userModel as application/json

Parameter userId as string

Method Name: deleteUserById
Removes a user and all his traditions

`DELETE` /deleteuser/withid/{userId}

Response as text/plain: OK on success or an ERROR in JSON format

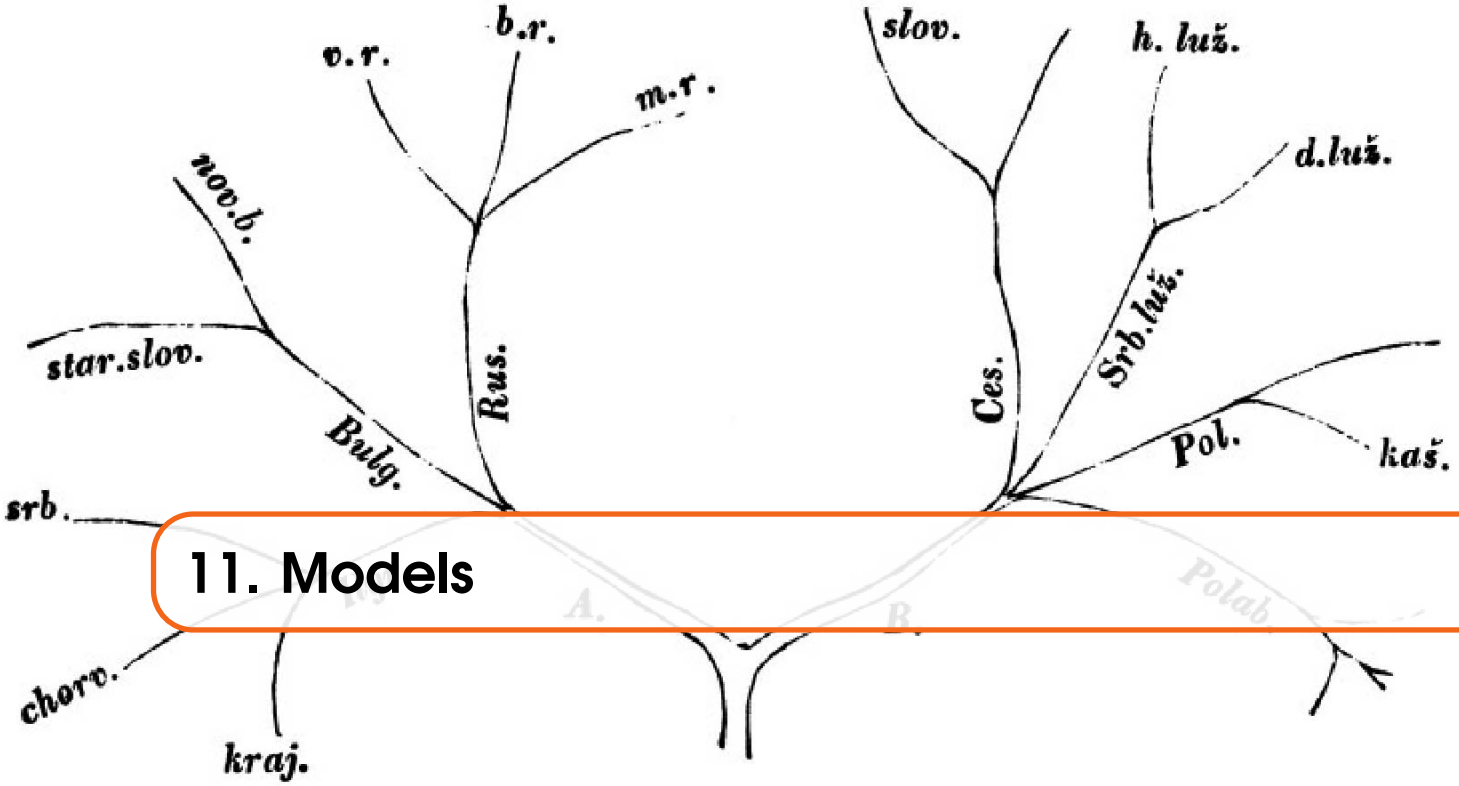
Parameter userId as string

Method Name: getTraditionsByUserId
Get all Traditions of a user

`GET` /gettraditions/ofuser/{userId}

Response as application/json: OK on success or an ERROR in JSON format

Parameter userId as string



11. Models

11.1 relationshipModel

- **Property** a_derivable_from_b as string
- **Property** alters_meaning as string
- **Property** annotation as string
- **Property** b_derivable_from_a as string
- **Property** displayform as string
- **Property** extra as string
- **Property** id as string
- **Property** is_significant as string
- **Property** non_independent as string
- **Property** reading_a as string
- **Property** reading_b as string
- **Property** scope as string
- **Property** source as string
- **Property** target as string
- **Property** type as string

Property witness as string

11.2 readingModel

Property grammar_invalid as string

Property id as string

Property is_common as string

Property is_end as string

Property is_lacuna as string

Property is_lemma as string

Property is_nonsense as string

Property is_ph as string

Property is_start as string

Property join_next as string

Property join_prior as string

Property language as string

Property lexemes as string

Property normal_form as string

Property rank as long

Property text as string

11.3 traditionModel

Property id as string

Property isPublic as string

Property language as string

Property name as string

Property ownerId as string

11.4 duplicateModel

Property readings as long

Property witnesses as string

11.5 graphModel

Property readings as long

Property witnesses as string

11.6 witnessModel

Property id as string

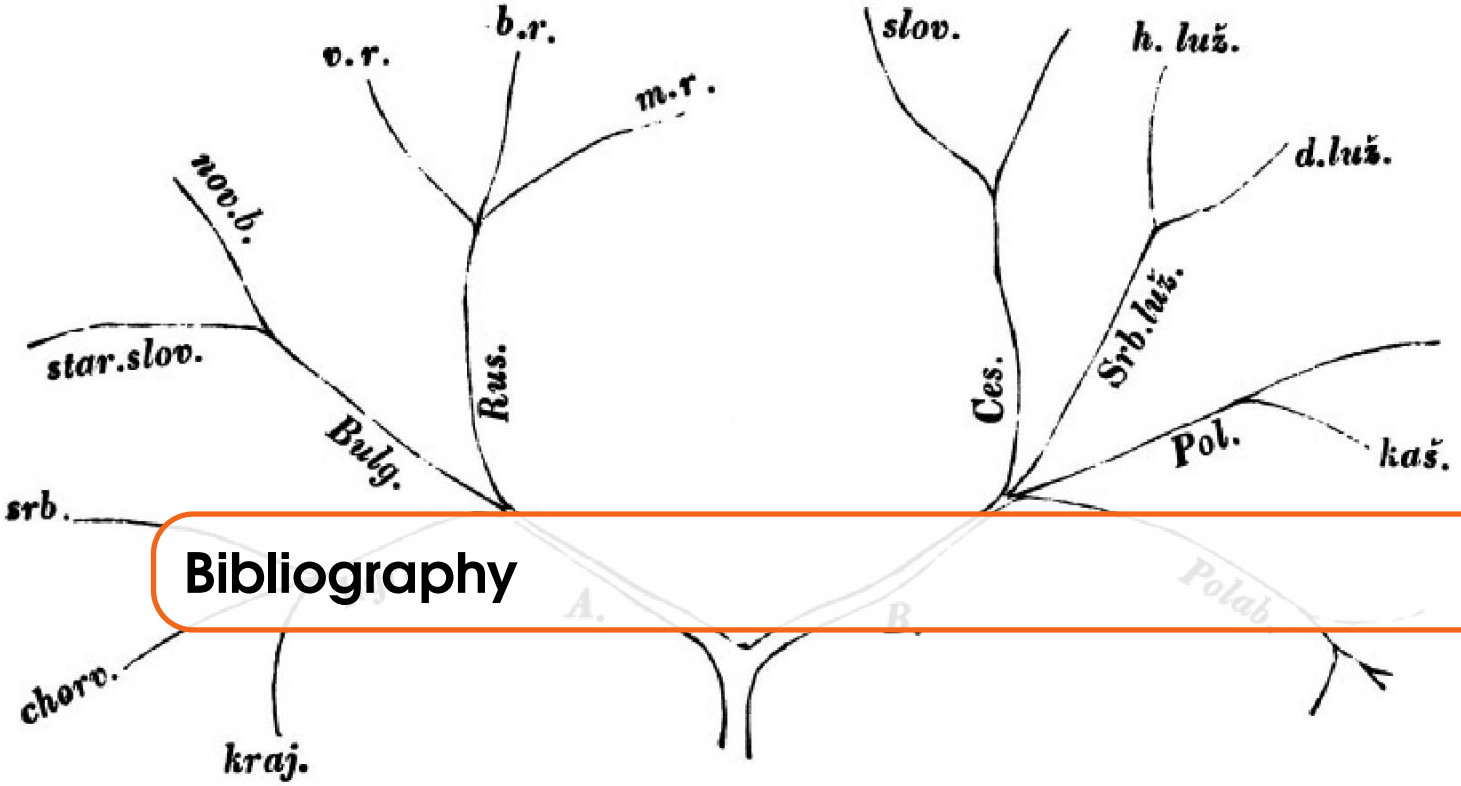
11.7 userModel

Property id as string

Property isAdmin as string

11.8 stemma

A tree that provides an overview over the witnesses of a tradition. The relations between the witnesses which are displayed as nodes is central. Here the stemmata are mostly returned in dot format.



Bibliography

Books

Articles