Stemmarest

Documentation of the PSE2 Project 2015

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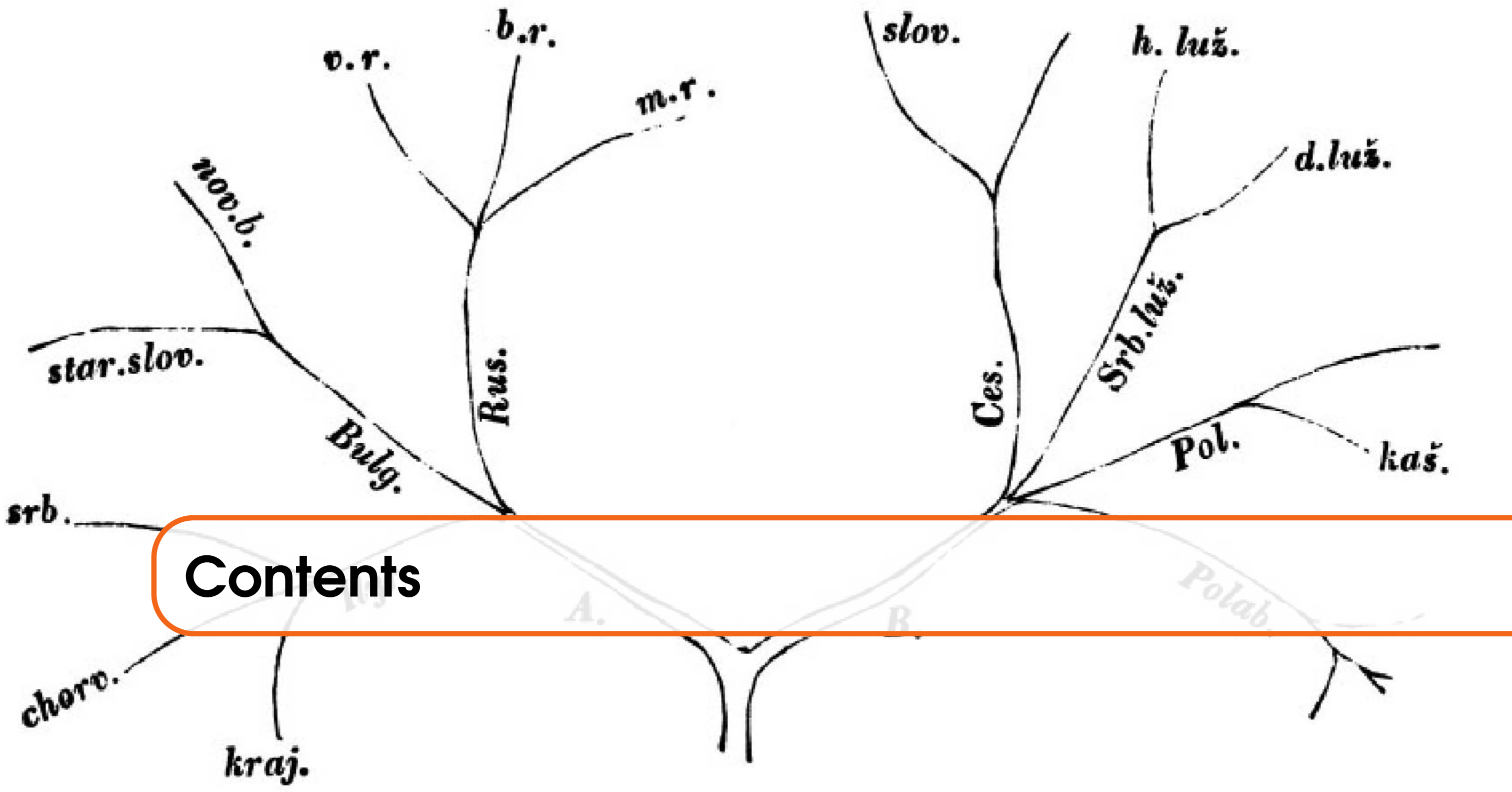
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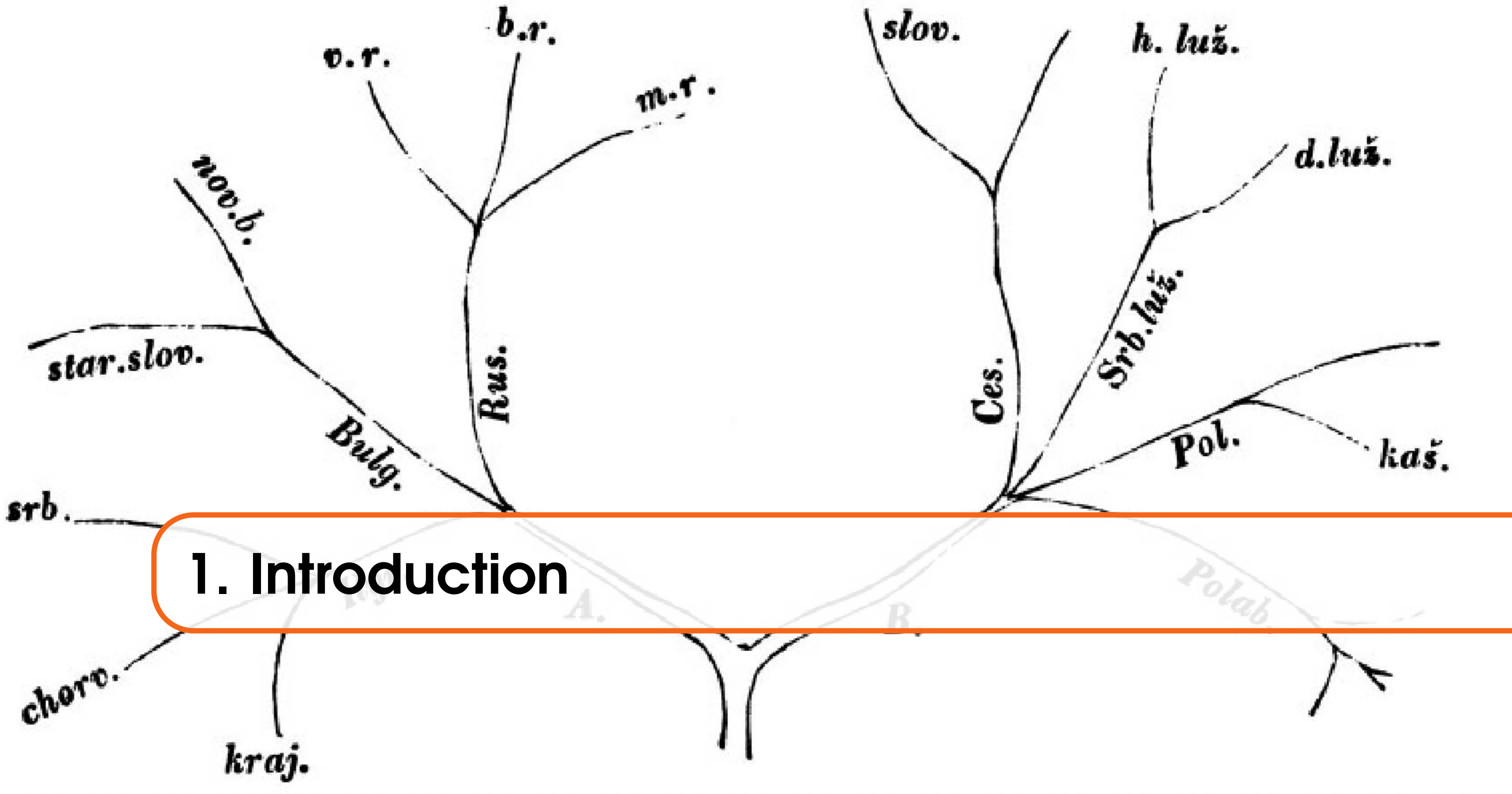

1. Introduction

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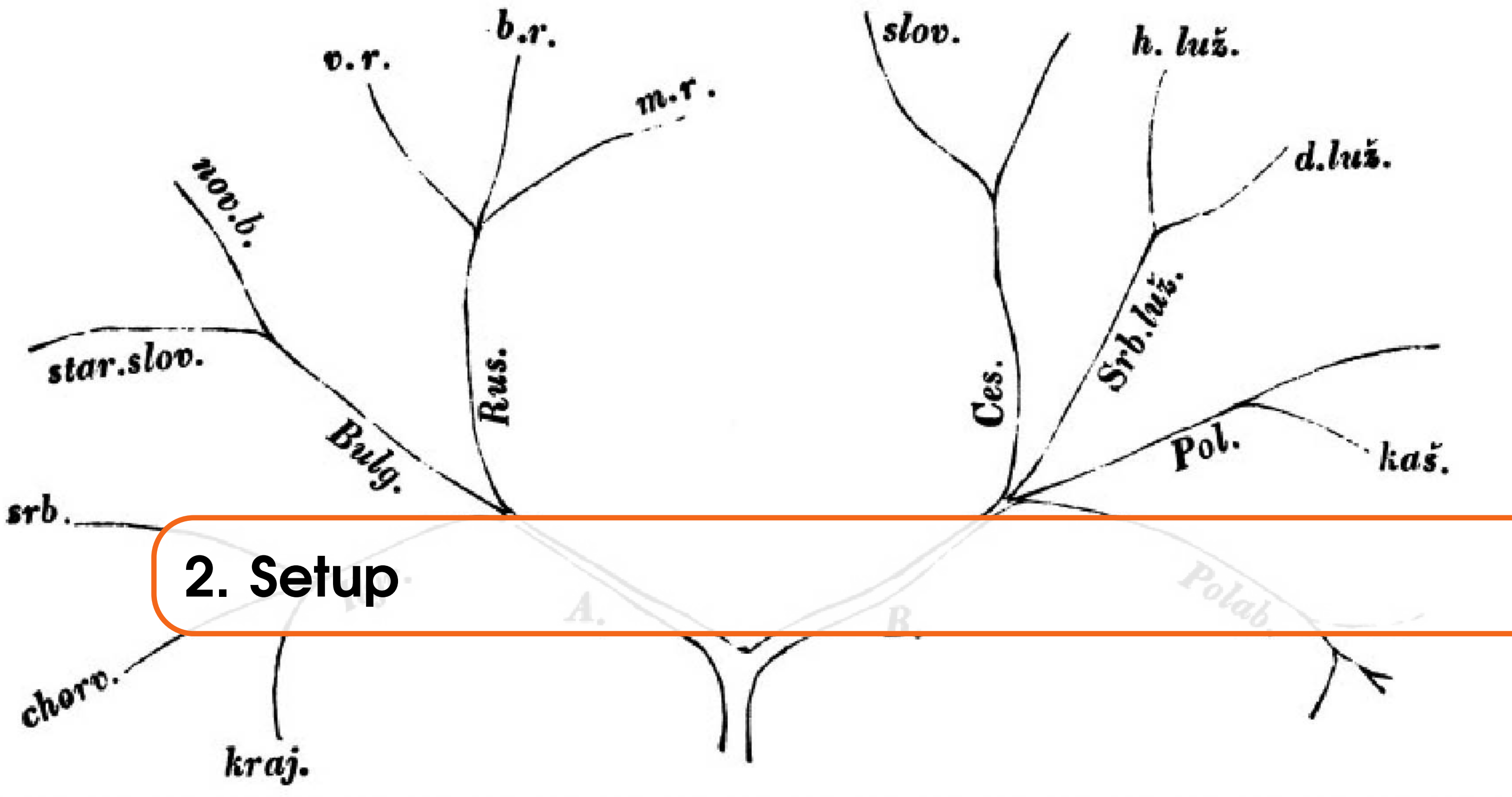


2. Setup

Downloading

git clone https://github.com/tohotforice/PSE2_DH.git

Building

Stemmarest needs to be built using Maven. This can be done using a java IDE (e.g Eclipse) and a Maven plugin

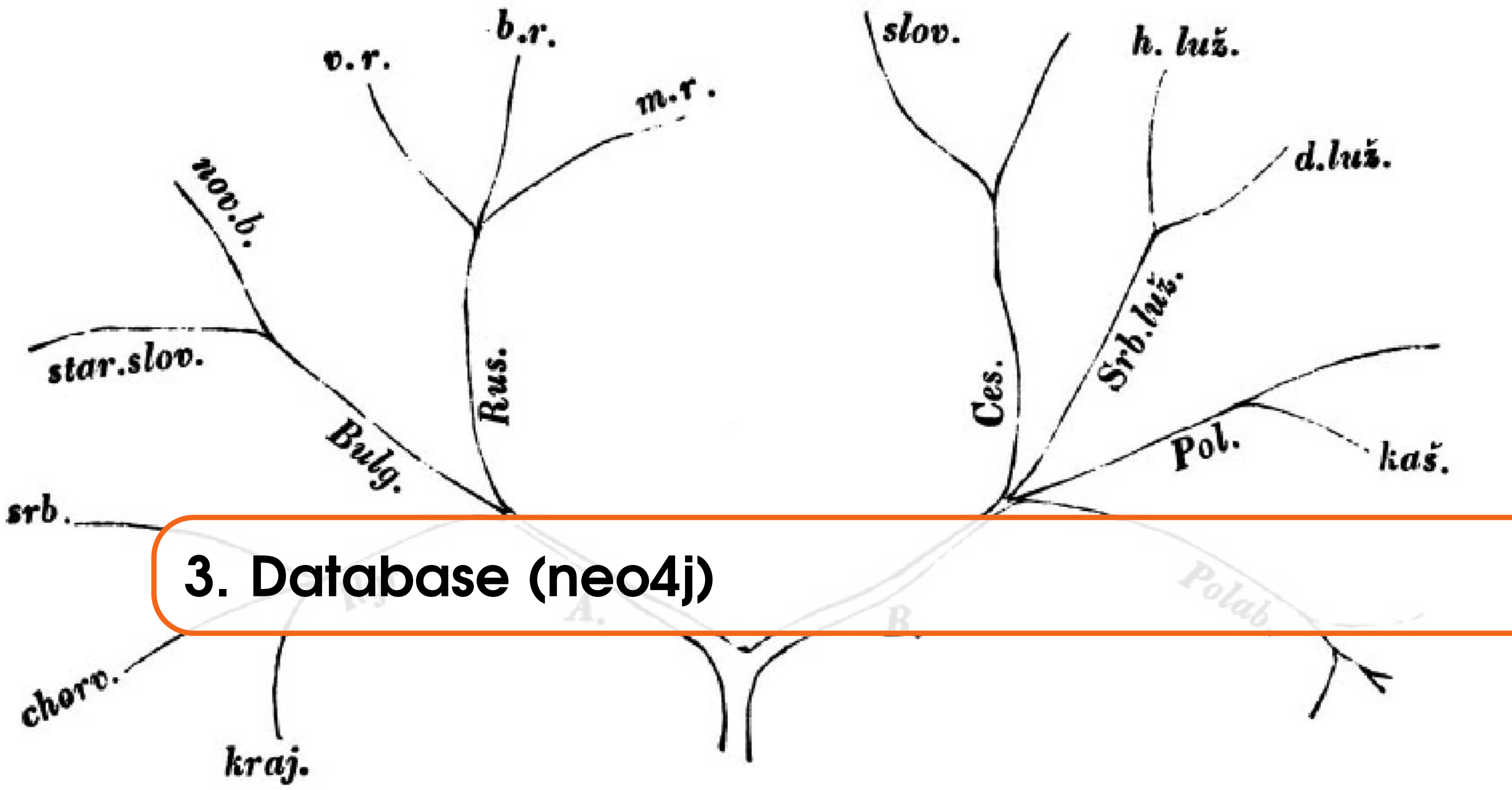
Running

As this application represents a server side only, there is no full GUI included. It is possible though to test it by using the test interface testGui.html which is located at StemmaClient.

Using the test interface

- Create a user and give it an id (this is necessary as every graph needs to be owned by a user)
- Import an GraphML file using the id of the user you have created. The generated id of the tradition will be returned
- Use the custom request by typing in the API call you want (all calls are listed in the documentation)

A word about node id's: when a graph is being imported each node gets from Neo4j a unique id-number. In order to use an id in an API call (e.g. reading-id) it is necessary to explicitly get it from the data base. This can be done by using the getAllReadings method (getallreadings/fromtradition/traditionId) or by actually going into the data base (see Neo4j visualization in section Database)



3. Database (neo4j)

In this project a graph database is used to store the data instead of a relational database.
This was due to the fact that graph databases are much faster when it comes down to look for objects in a list that fulfil some constraints to other objects. In a relational database one would normally use multiple joins to get the desired result. By using a graph this task becomes much easier since it is possible to traverse the graph from node to node using either breadth- or depth-first algorithm and look for a specific relation between two nodes, which represent objects. This could make a search of objects, which are connected to each other, very efficient.

We have chosen to use Neo4J (Additional info can be found under http://neo4j.com/developer/graph-db-vs-rdbms/) which is a graph database capable of very efficiently finding and managing nodes and relationship even in a large scale graph.
Additional information regarding benchmarking could be found in the related chapter of this documentation.

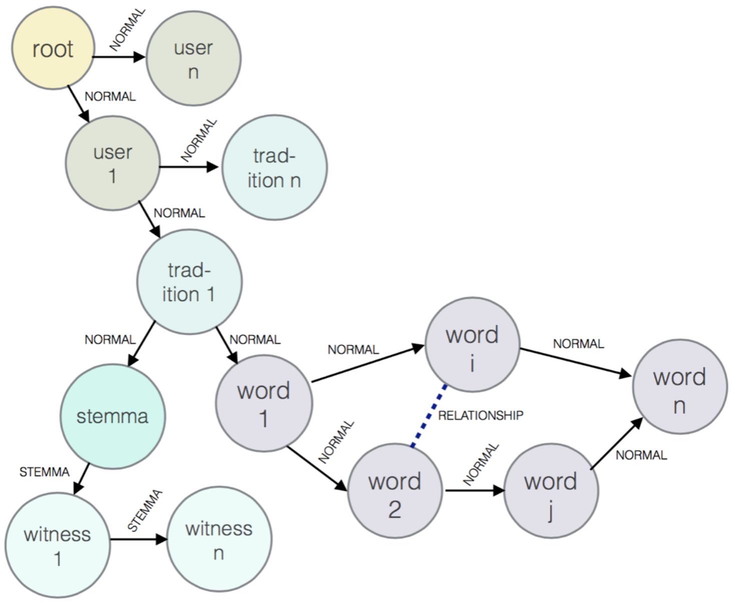
The stemmaweb database is basically a one big graph, with different Labels marking different Nodes and Relationships to increase the search speed.

Only a few labels are used in the database:

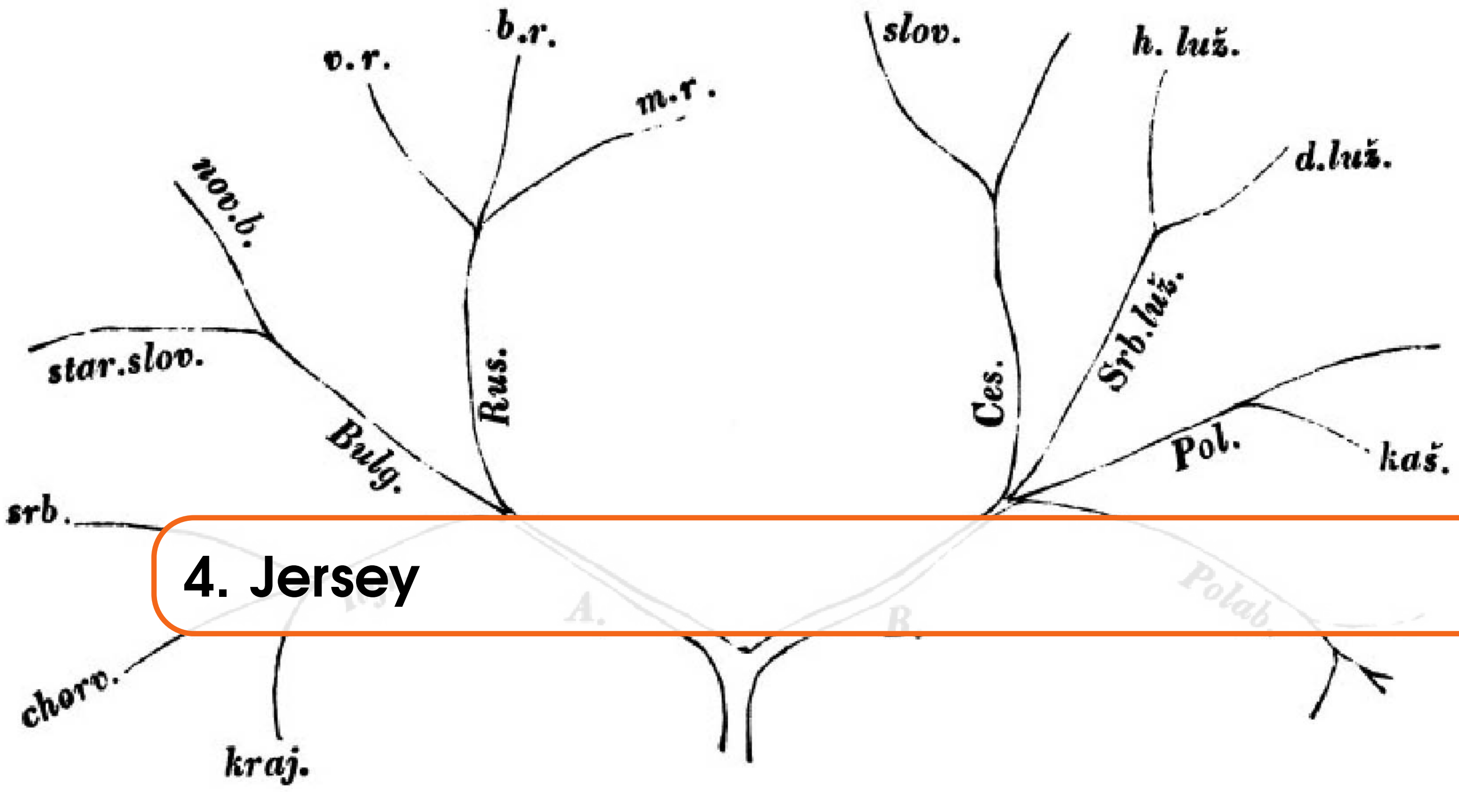
Nodes	**Relationships**
ROOT	RELATIONSHIP
STEMMA	STEMMA
WITNESS	NORMAL
TRADITION	
USER	
WORD	

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

The database structure is as follows:



Neo4J uses 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 one can write simple queries that return nodes or traverse graphs. But as Cypher queries need to be interpreted and translated into an execution plan they are still less fast then the native java traversal API which is therefore the common query tool used in the project.



4. Jersey

Introduction

Jersey is an open source java 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. Jersey helps support exposing the data in different media types, including JSON, which is very frequently used in this program.

Method Declarations

An example of the method declaration of duplicateReading in the reading class:

```
@POST
@Path("duplicatereading")
@Consumes(MediaType.APPLICATION_JSON)
@Produces(MediaType.APPLICATION_JSON)
public Response duplicateReading(DuplicateModel duplicateModel)
```

The @POST annotation states the http method. The @Path annotation sets the url path. The method can "consume" data sent by the client, which is in this case a java object of a "Duplicate-Model", which is passed with the call as a JSON object and then gets parsed by the server into a POJO. The method "produces" a response, which is the method's return value, in this case also in JSON.

And here another example from the witness class:

```
@GET
@Path("gettext/fromtradition/{tradId}/ofwitness/{witnessId}")
@Produces(MediaType.APPLICATION_JSON)
public Response getWitnessAsText(@PathParam("tradId") String tradId,
        @PathParam("witnessId") String witnessId) {
```

The values in curly braces in the path (tradId and witnessId) are path parameters, which are used in the method. In the method declaration they are annotated with @PathParam.

Resources

In the ApplicationConfig class all the "resources" are loaded in the following method:

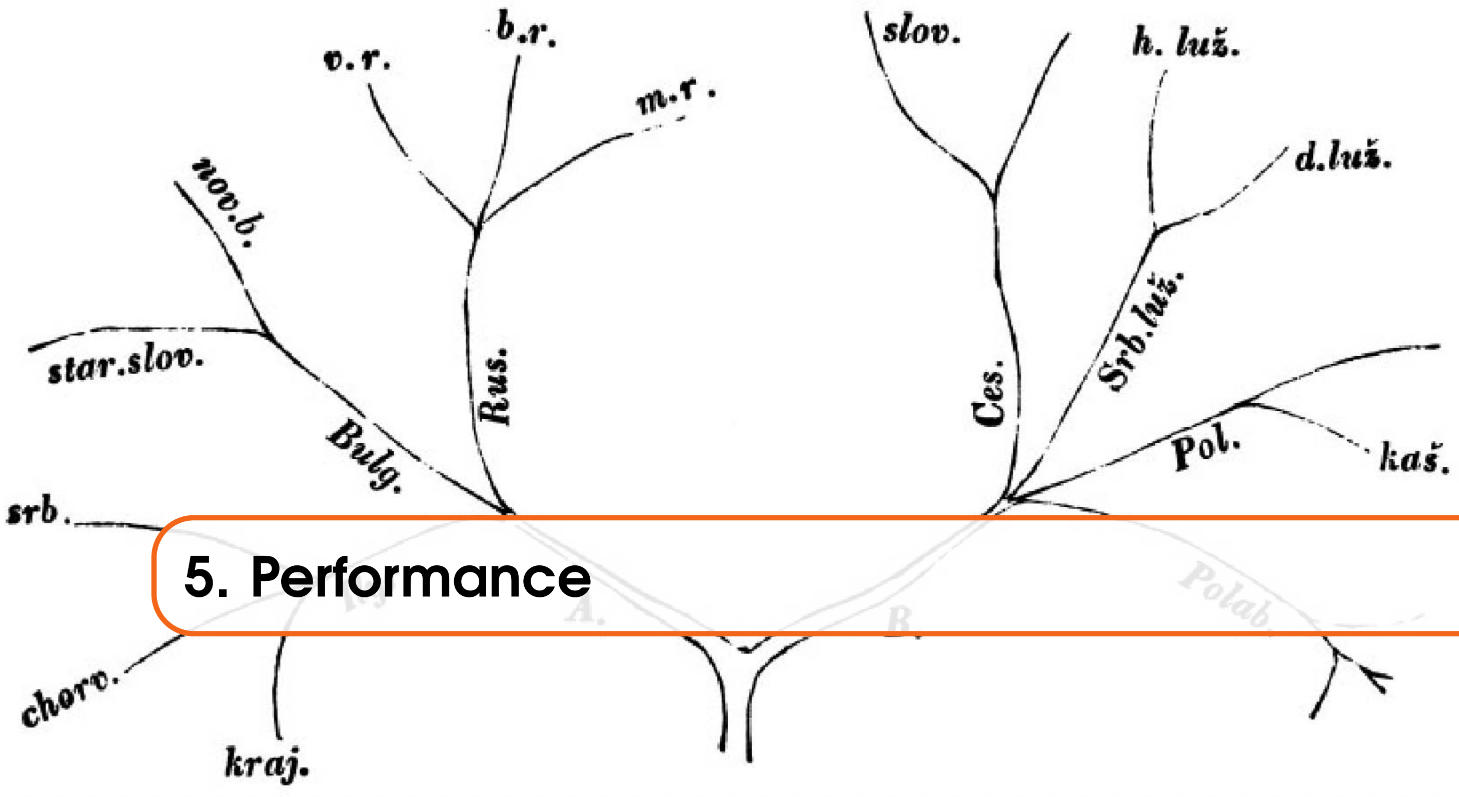
```
@Override
public Set<Class<?>> getClasses() {
        Set<Class<?>> s = new HashSet<Class<?>>();
        s.add(Witness.class);
        s.add(User.class);
        s.add(Tradition.class);
        s.add(Relation.class);
        s.add(Stemma.class);
        s.add(Reading.class);

        return s;
}
```

A "resource" is a class that provides methods annotated with @GET, @POST, @PUT or @DELETE. So all the api calls that can be made using stemmarest are defined in these six classes: Witness, User, Tradition, Relatino, Stemma and Reading.

```
@Path("/reading")
public class Reading implements IResource {
```

All of these classes implement the IResource interface which declarates the class as a resource. Additionally the path of the database is set in this interface. It can be seen that a path can also be set for an entire class. That means that it is set before each method of this class. So duplicateReading to take the example from above can be reached under "baseurl/reading/duplicatereading".



5. Performance

One of the main goals of this project is it to create a RESTful service which is significantly faster then the existing one. To assure the speed of the service some performance tests are done.

The goal of the performance tests is to show that the response time of the service is limited and within a usable range, therefore the tests measure the time to execute all operations for a certain request. This includes 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 is transmitted over the local loop interface, so the network speed is not measured.

For the purpose of the tests the database is being populated by a random graph which contains several valid traditions on which the REST requests can be executed. Several tests with databases of different sizes are done to show that the response time does not change while the size of the database increases. (There are several Node-ID queries 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 as the size of the database grows).

In the following measurements are a result of tests which test the dimension of the database. Those 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 in which a query can search on a subgraph without filtering the whole database.

R The implementation of stemmarest uses some search node by id methods (a part of Neo4j framework) which search over the complete database. It is then important to realize that those quarries are done on $O(logn)$ time and are not seen in the noise of the other operations during the tests. In a much bigger Database those methods will slow down the REST requests, though it is not expected that the database will grow so big that such operations will have any impact.

The previous measurement test the dimension of the database and could show that the response time is almost independent to its size between 1000 and 1 Million Nodes (Readings). This indepen-

Figure 5.1: Database with 1000 nodes, working tradition with 100 nodes

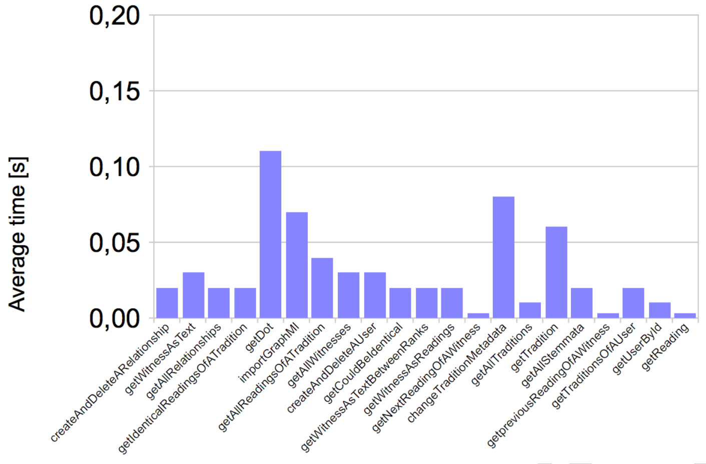


Figure 5.2: Database with 100000 nodes, working tradition with 100 nodes

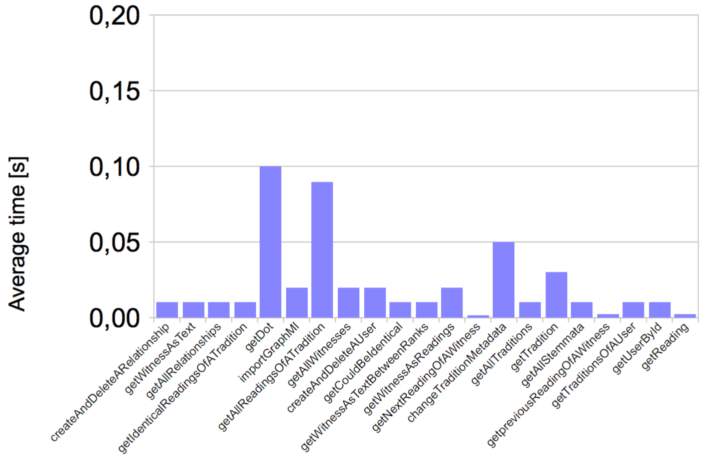
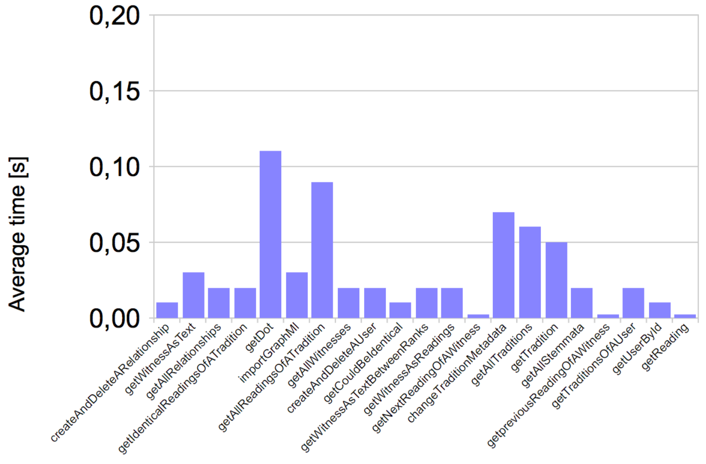


Figure 5.3: Database with 1000000 nodes, working tradition with 100 nodes



dence is a results 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 obvious the tradition size have an influence on the speed of those algorithms, as the working subset grows with a bigger tradition. Most of the algorithms which work on a tradition are in $O(logn)$, though 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 tests the dimension of the tradition is varied. Those measurements show

Figure 5.4: Database with 10000 nodes, working tradition with 1000 nodes

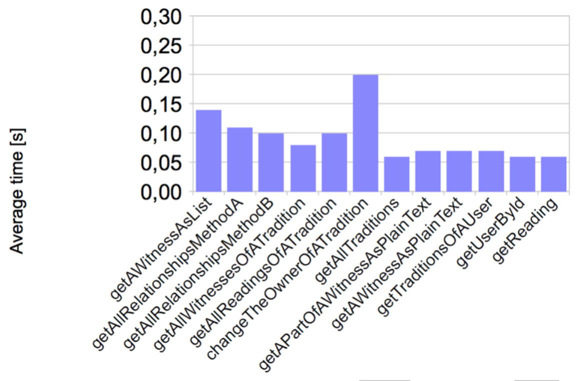
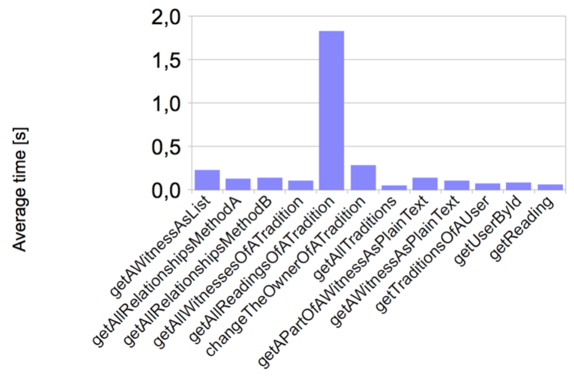


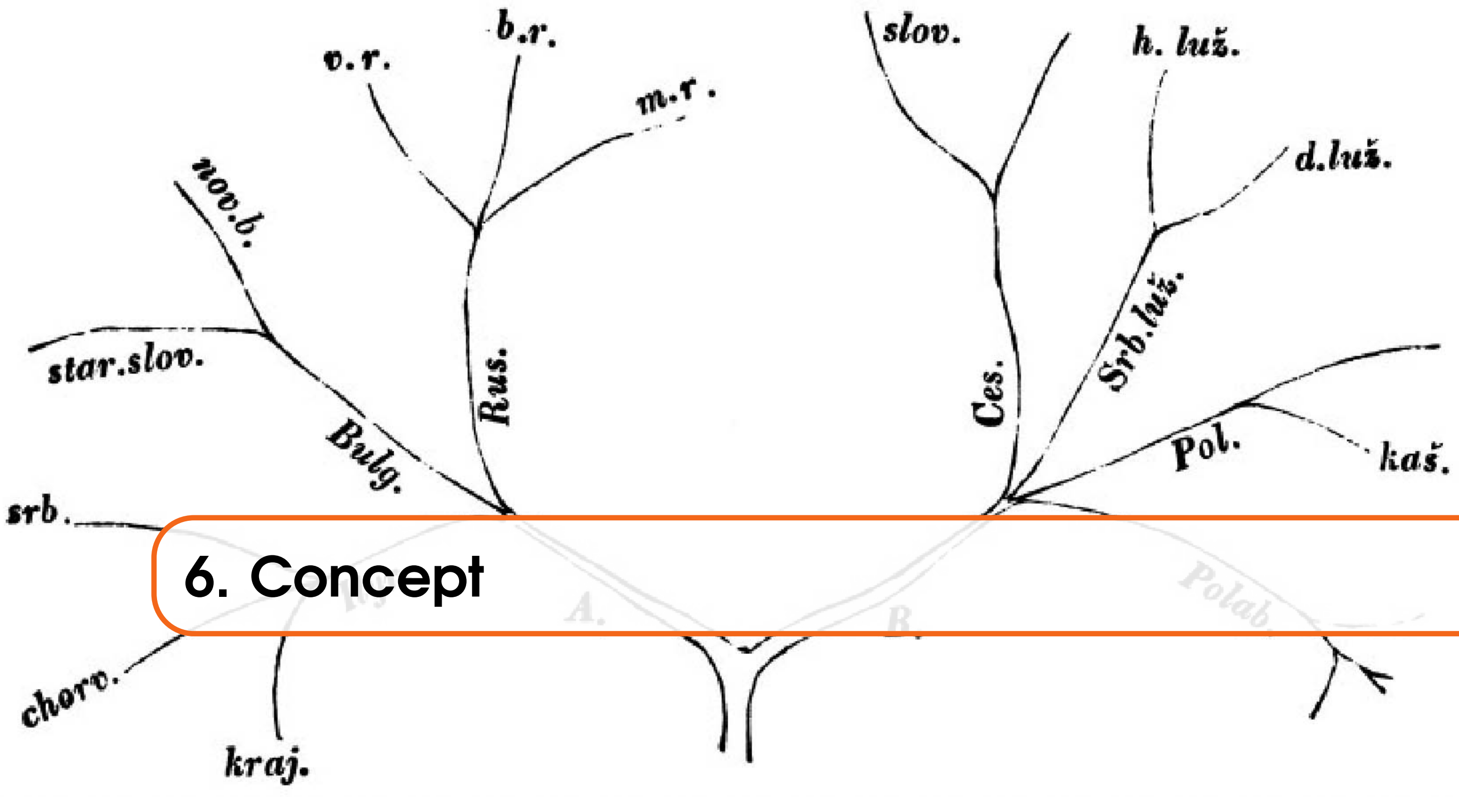
Figure 5.5: Database with 10000 nodes, working tradition with 10000 nodes



that the execution time depends on the size of the working tradition, as in the results for the getAll-ReadingsFromATradition method, in which 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



6. 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 such a manner that they do not have any impact on the architecture of the project.

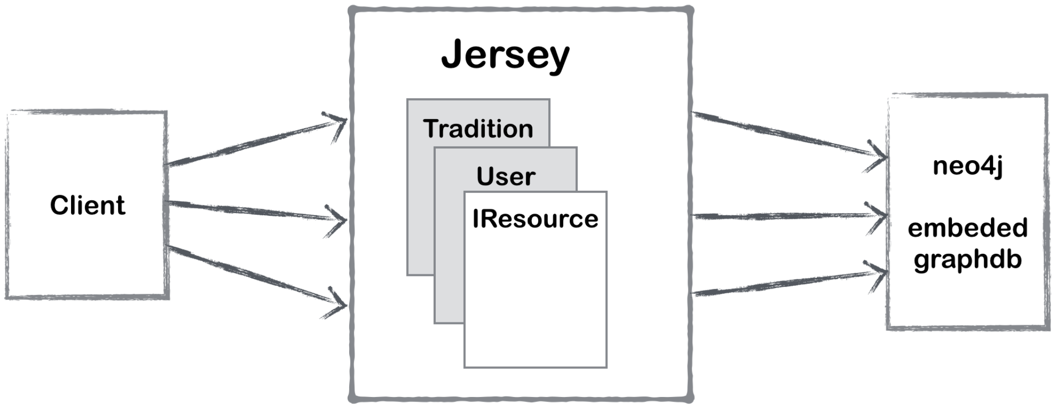
Integration Tests

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

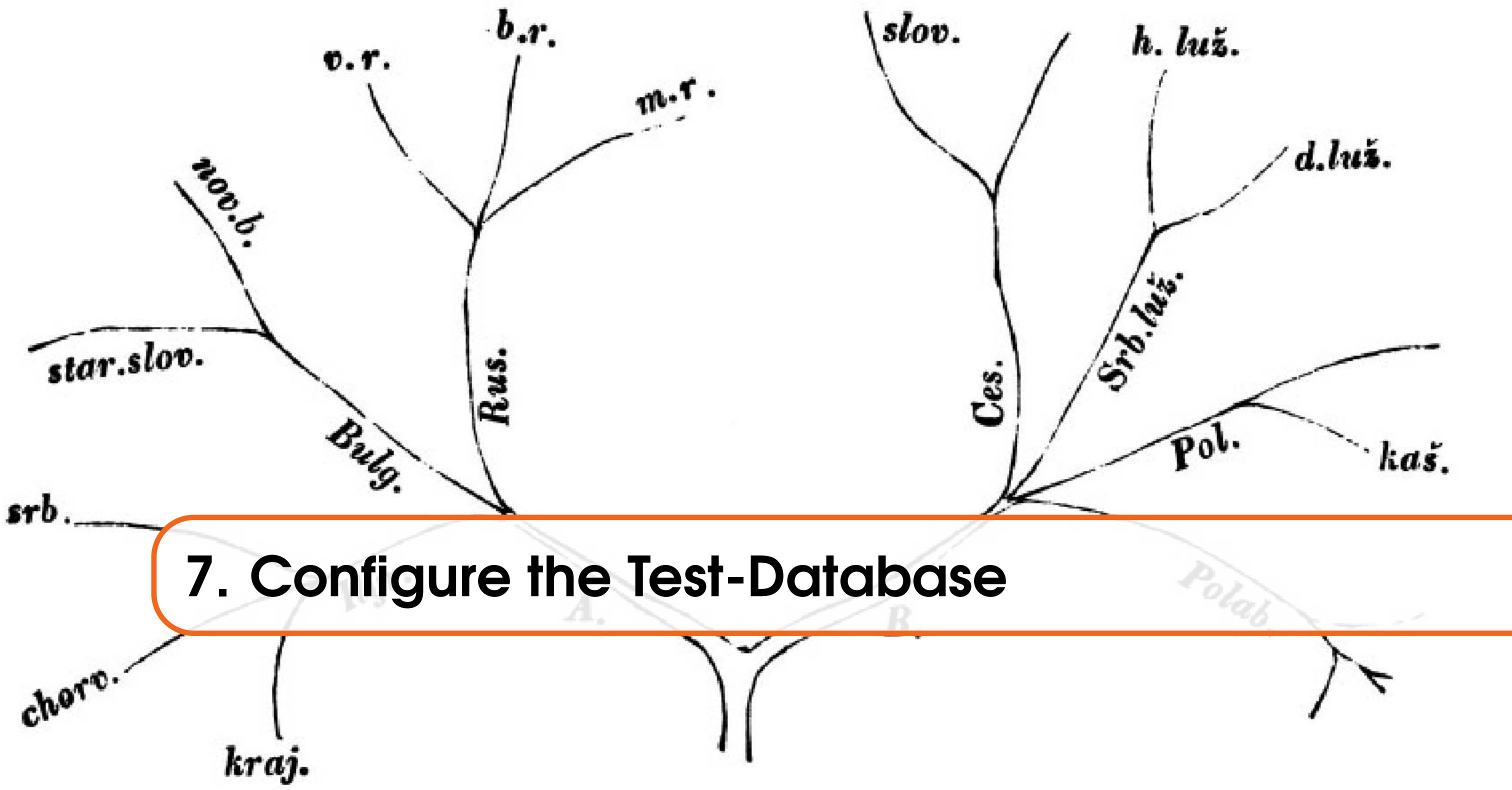
Unit Tests

Unit tests are used for test-driven-development and are defined by the developer. They are only used for the development process and are not a referenced to the quality of the end product.

Jersey Overview



In the productive system, for every REST call a jersey instantiate the requested IResource and provides the service. A global singleton GraphDatabaseService object is used to provide the GraphDatabaseService. In production this GraphDatabaseService is an embedded neo4j GraphDatabase. 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 is configured to return an impermanent Database. As the GraphDatabaseService is a singleton object this configuration needs to be done before the start-up of the Jersey Testserver.



7. 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();
```

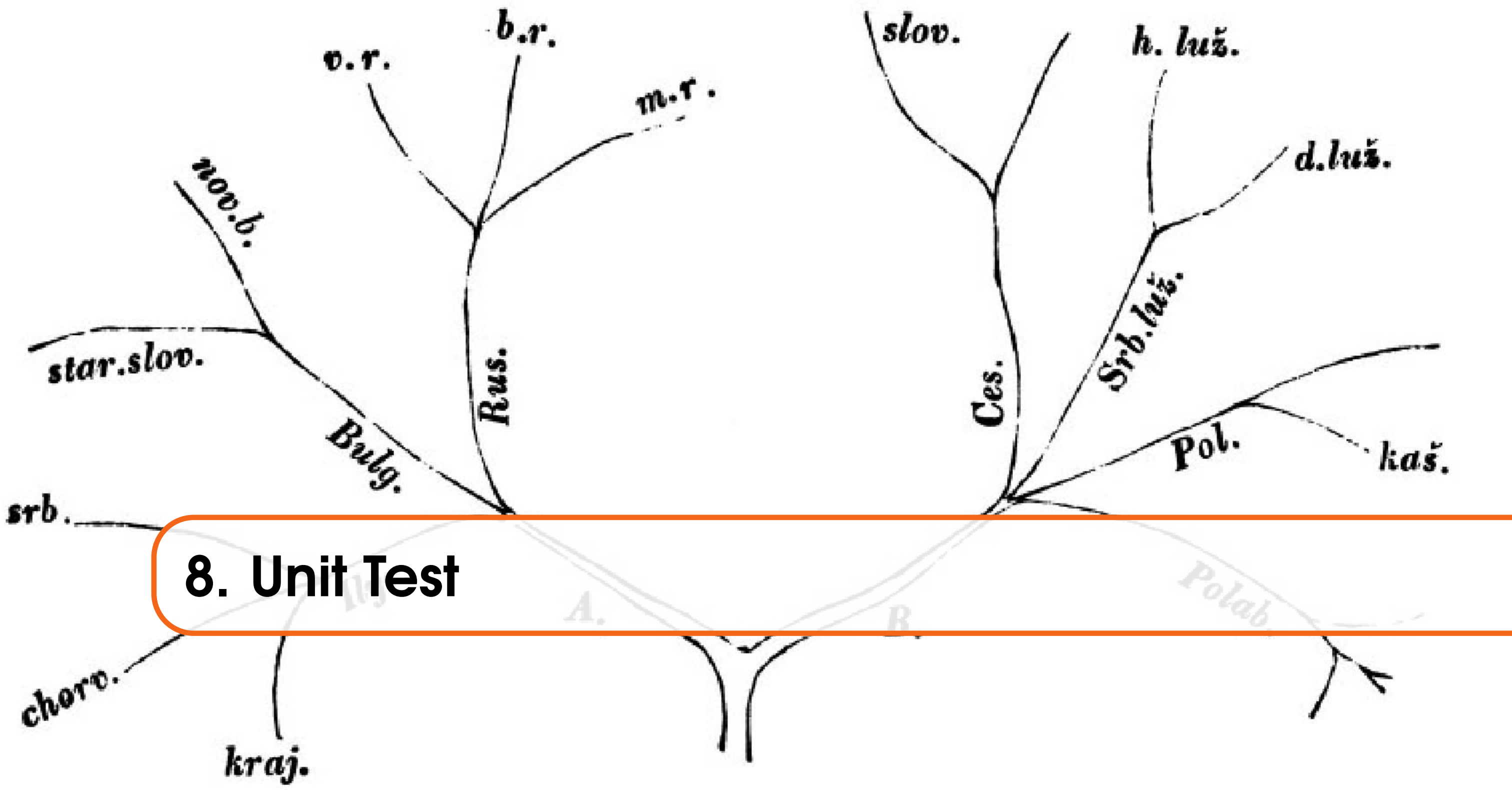
Later the db object can be initialized by:

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

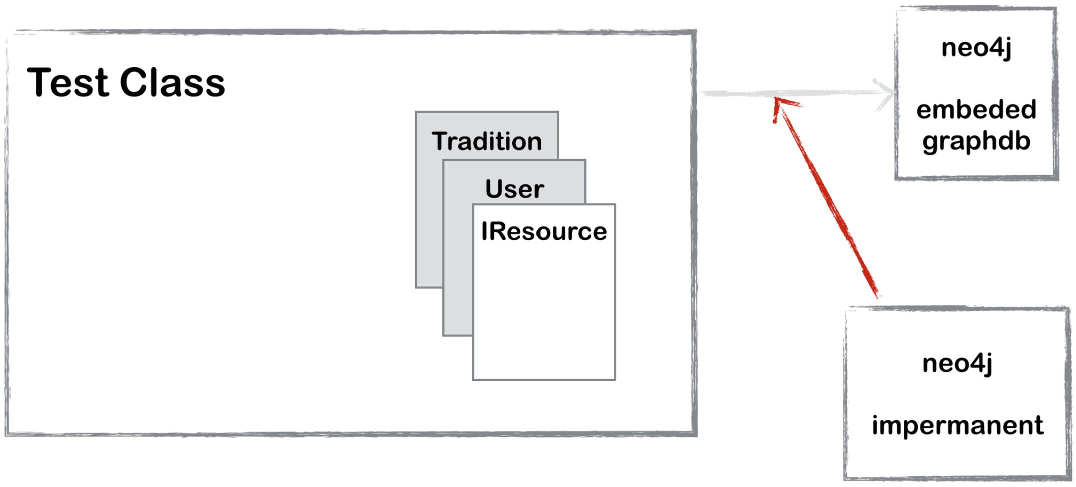
In the @After method the database has to be closed

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

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



8. Unit Test

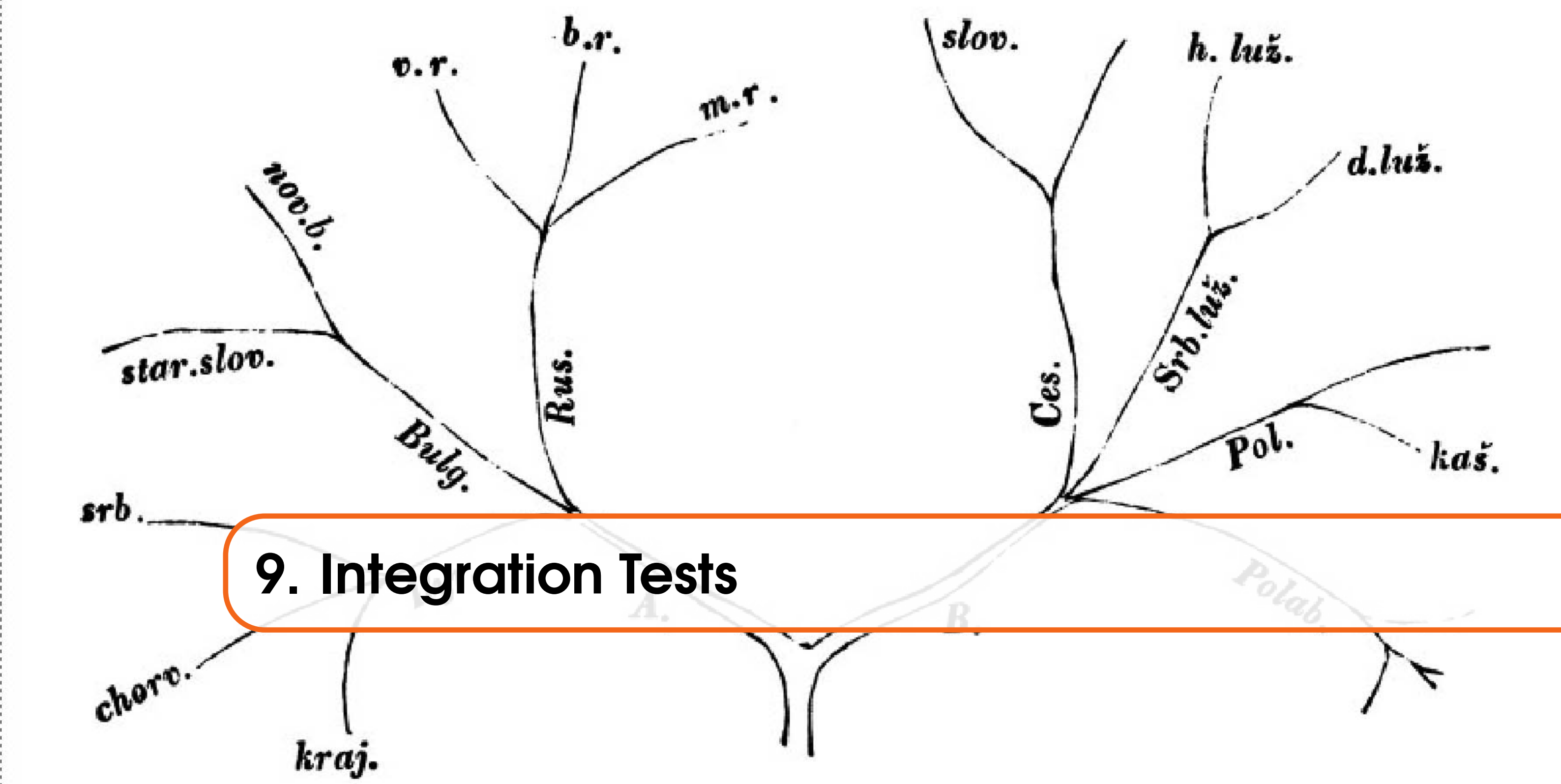


For Unit Tests the methods of the resource are called directly.

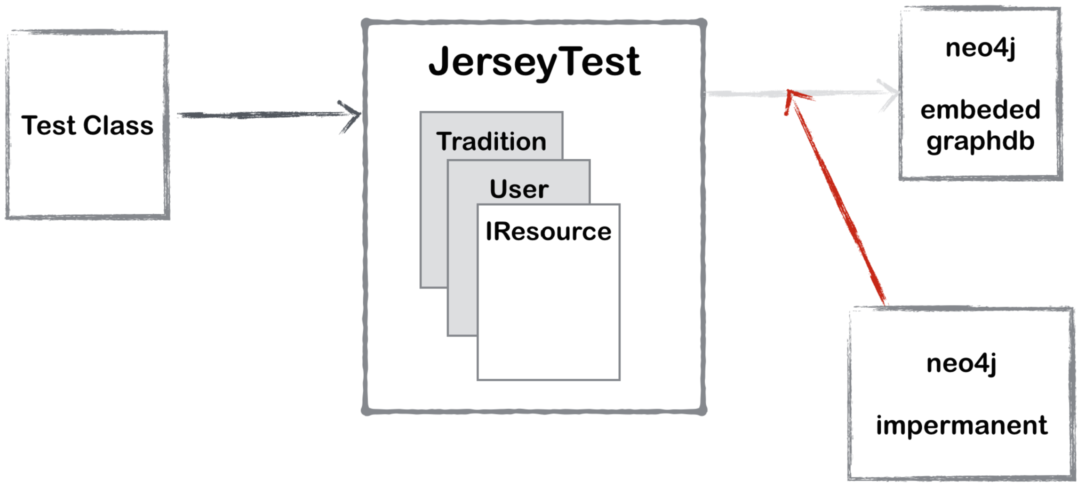
```
@Test
public void SimpleTest(){
   String actualResponse = userResource.getIt();
   assertEquals(actualResponse, "User!");
}
```

Example

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



9. 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();
```

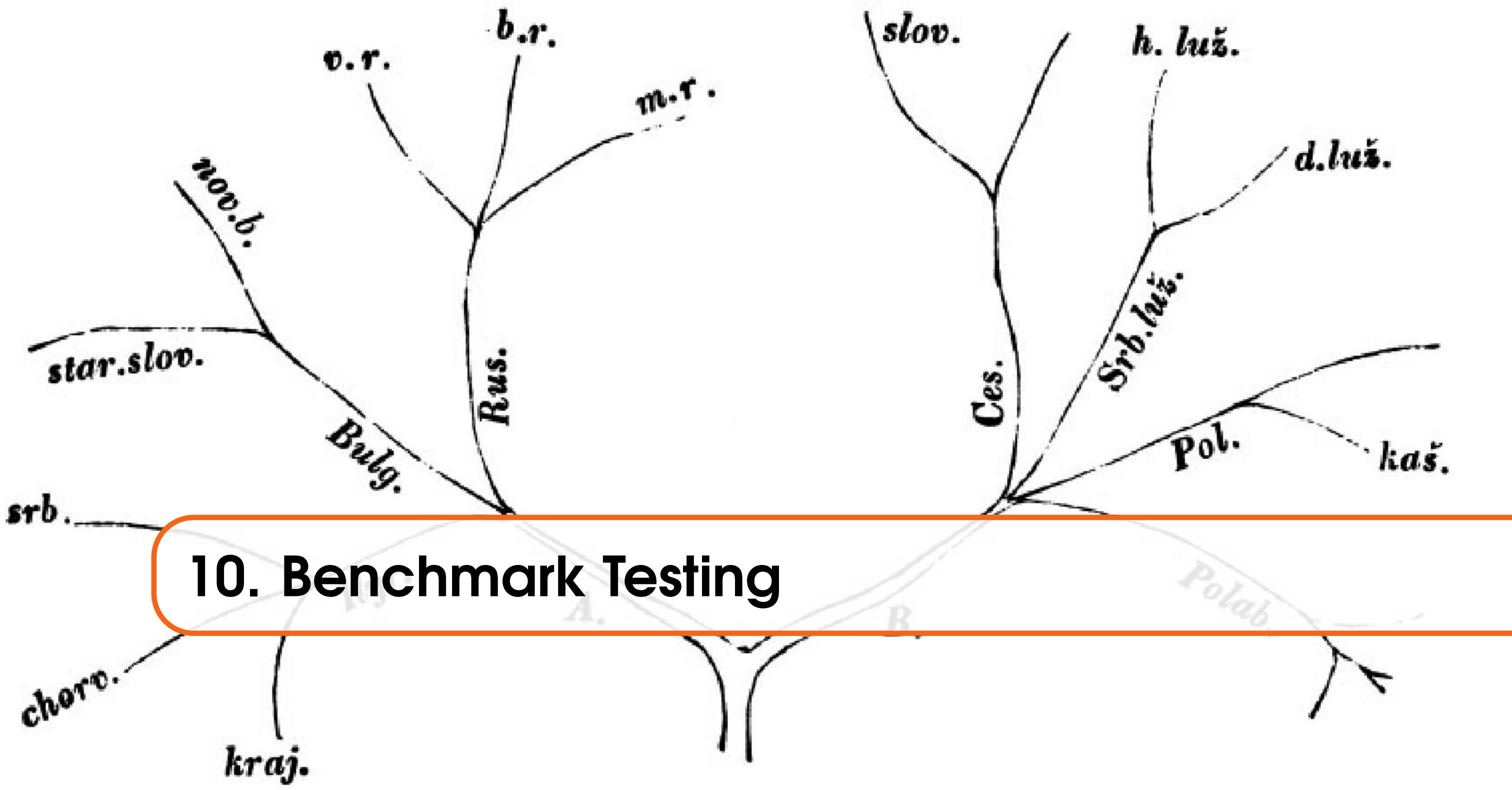
The test is done by calling a webresource of jerseyTest

```
@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



10. Benchmark Testing

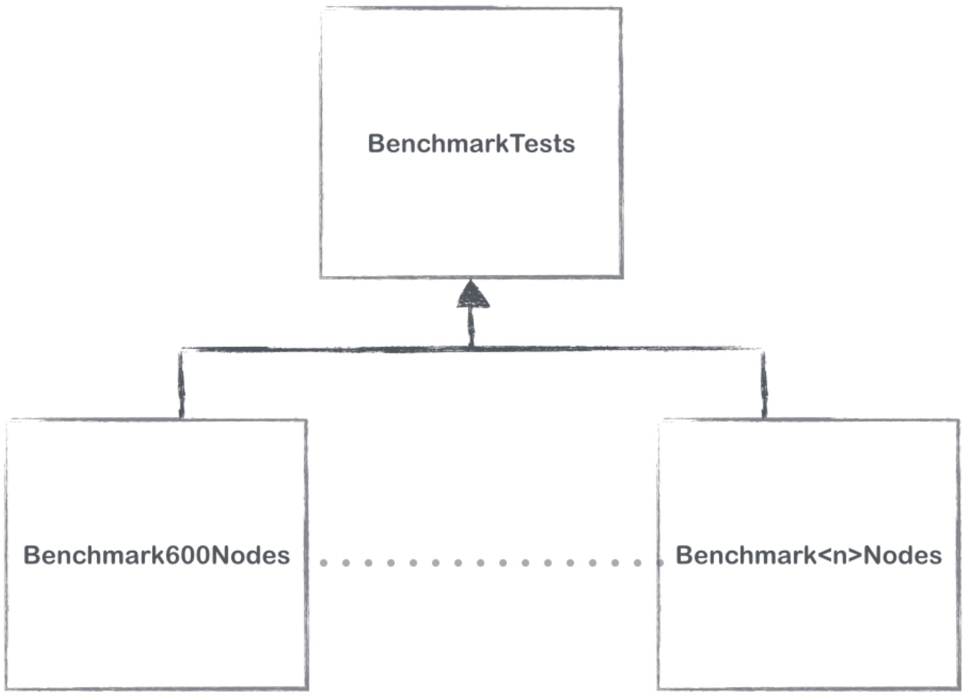
The main goal of the stemmarest project is to achieve better performance then the previous service. To measure the performance of the system benchmark testing is needed. A benchmark test basically calls the RESTful service multiple times and measure the response time. To achieve this *com.carrotsearch.junitbenchmarks* 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 effective benchmark testing it is important to have a variety of different databases. Those databases should differ in size from small to very huge. This allows to measure the algorithms in extreme situations. To generate valid graphs only limited by space the class *RandomGraphGenerator* can be used. By calling this static method 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. 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 generator. In it it is being configured how many nodes the database has. Those are also the classes which run with the JUnit test. BenchmarkTests cant be run as a JUnit test as it is an abstract class.



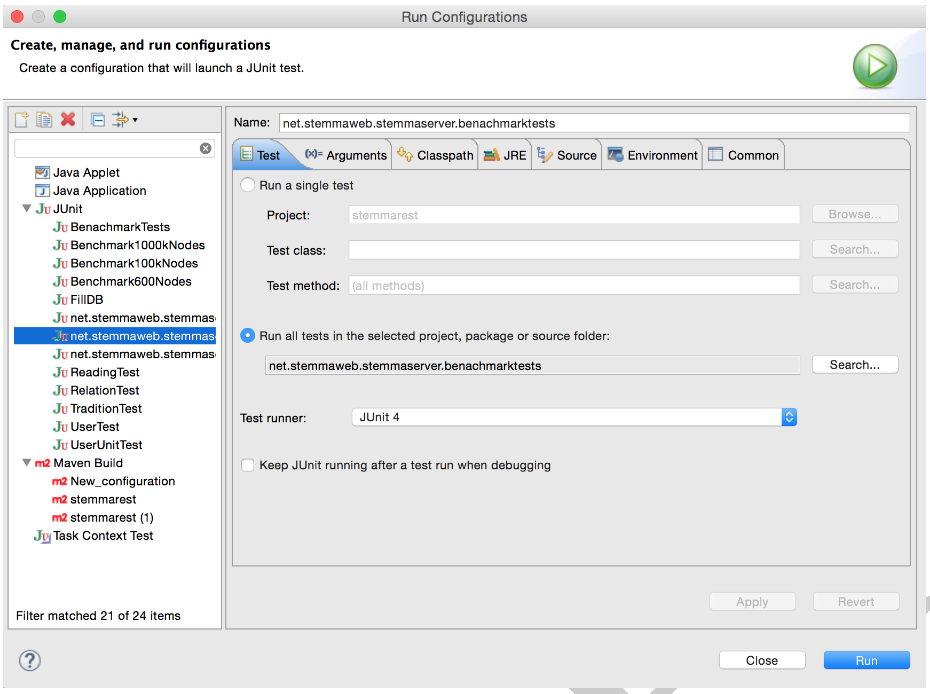
Tests are simply implemented in the BenchmarkTests class with the @Test annotation. It is best practice only to implement the restcall in this method and only test if Response.Status is OK. This assures that as low as possible overhead time will be measured. The integration- and JUnit tests should be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

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. To generate the report, though, an argument needs to be passed. Create a JUnit Test as follows:



Run Configurations

Create, manage, and run configurations

Create a configuration that will launch a JUnit test.

- Java Applet
- Java Application
- JUnit
  - BenachmarkTests
  - Benchmark1000kNodes
  - Benchmark100kNodes
  - Benchmark600Nodes
  - FillDB
  - net.stemmaweb.stemmas
  - net.stemmaweb.stemmas
  - net.stemmaweb.stemmas
  - ReadingTest
  - RelationTest
  - TraditionTest
  - UserTest
  - UserUnitTest
- Maven Build
  - New_configuration
  - stemmarest
  - stemmarest (1)
- Task Context Test

Filter matched 21 of 24 items

Name: net.stemmaweb.stemmaserver.benachmarktests

Test | Arguments | Classpath | JRE | Source | Environment | Common

Run a single test

Project: stemmarest

Test class:

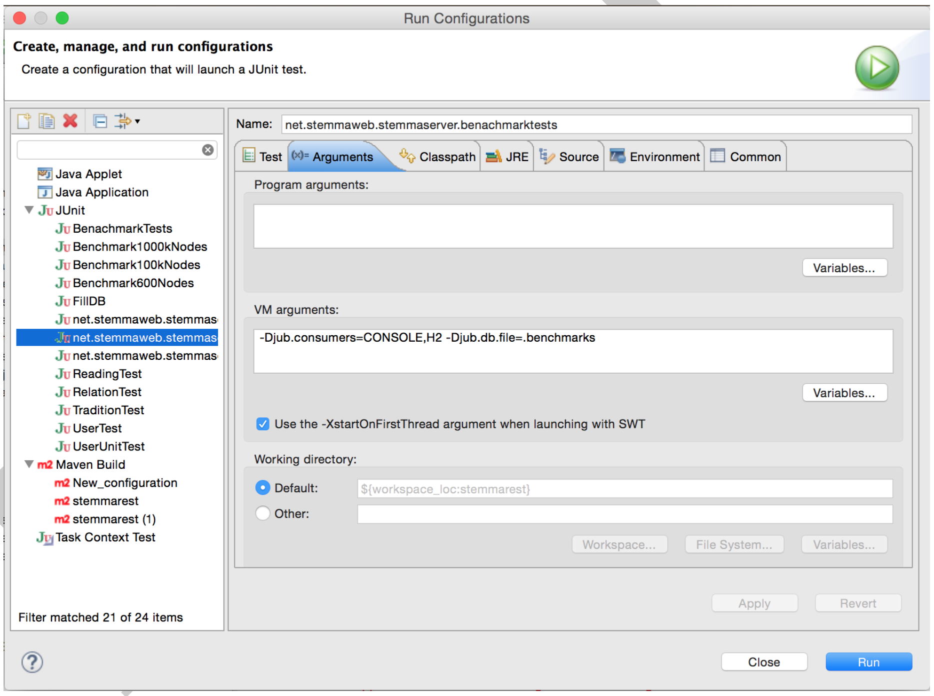
Test method: (all methods)

Run all tests in the selected project, package or source folder:

net.stemmaweb.stemmaserver.benachmarktests

Test runner: JUnit 4

Keep JUnit running after a test run when debugging



Run Configurations

Create, manage, and run configurations

Create a configuration that will launch a JUnit test.

Filter matched 21 of 24 items

Name: net.stemmaweb.stemmaserver.benachmarktests

Test | Arguments | Classpath | JRE | Source | Environment | Common

Program arguments:

VM arguments:

```
-Djub.consumers=CONSOLE,H2 -Djub.db.file=.benchmarks
```

✓ Use the -XstartOnFirstThread argument when launching with SWT

Working directory:

Default: ${workspace_loc:stemmarest}

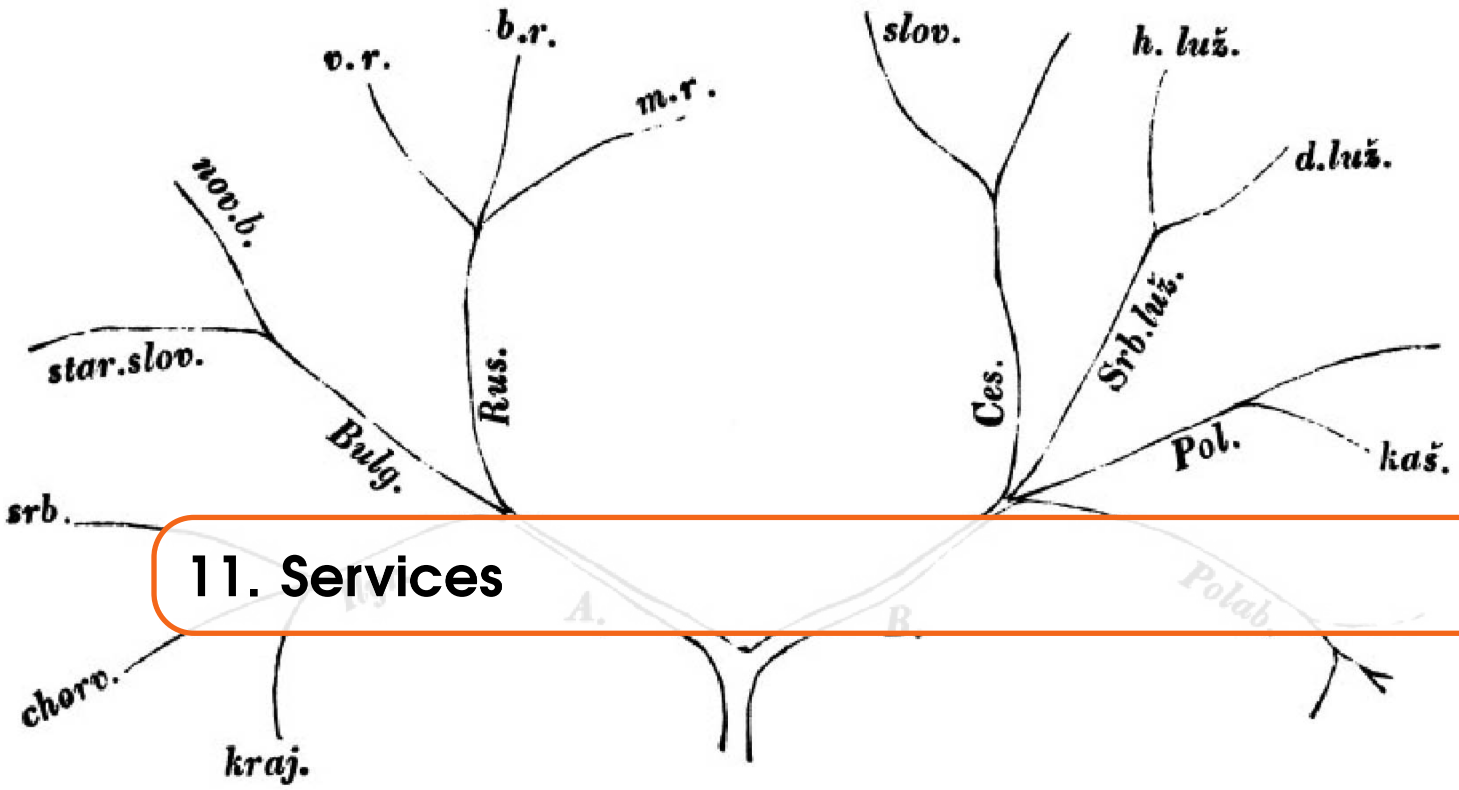
Other:

On the tab Arguments *-Djub.consumers=CONSOLE,H2 -Djub.db.file=.benchmarks* has to be inserted into the VM Arguments input. After that 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 need to generate huge graphs. Its recommended not to use the computer for other assignments during this tests.

III

RESTful API



11. Services

11.1 Baseresource:

http://localhost:8080/

11.2 /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

11.3 /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

11.4 /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

11.5 /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

11.6 /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

11.7 /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

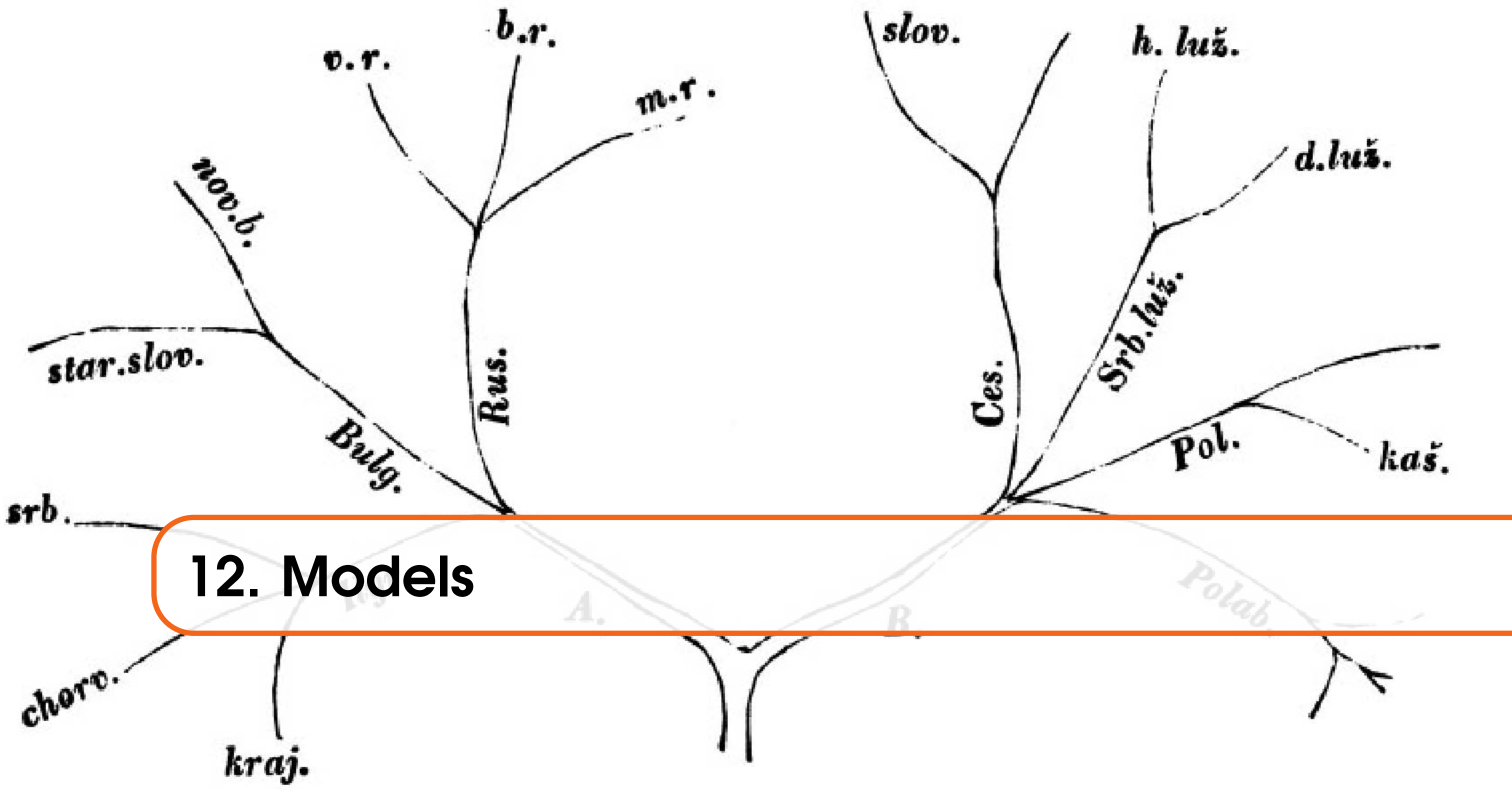
Parameter userId as string

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



12. Models

12.1 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

12.2 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

12.3 traditionModel

Property id as string

Property isPublic as string

Property language as string

Property name as string

Property ownerId as string

12.4 duplicateModel

Property readings as long

Property witnesses as string

12.5 graphModel

Property readings as long

Property witnesses as string

12.6 witnessModel

Property id as string

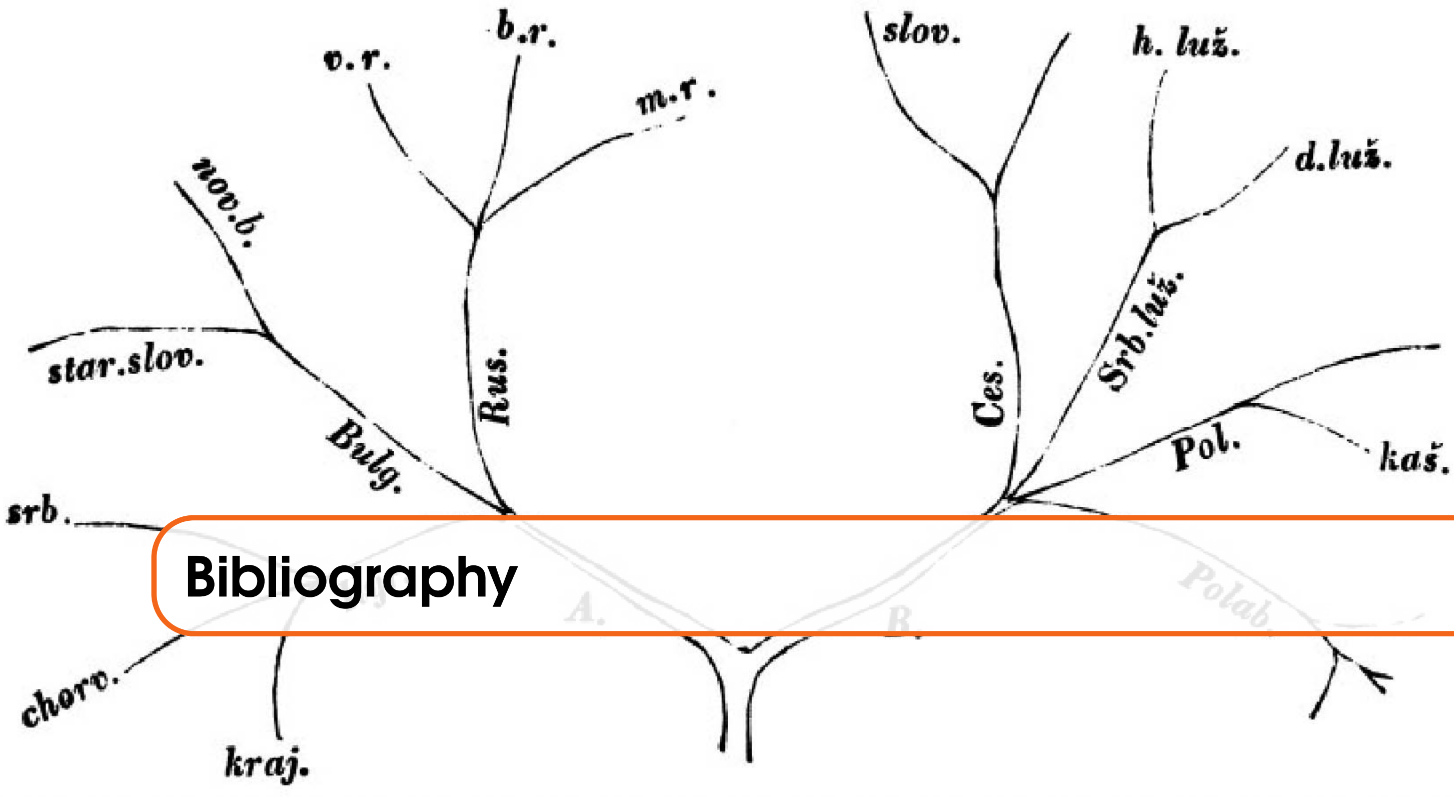
12.7 userModel

Property id as string

Property isAdmin as string

12.8 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