

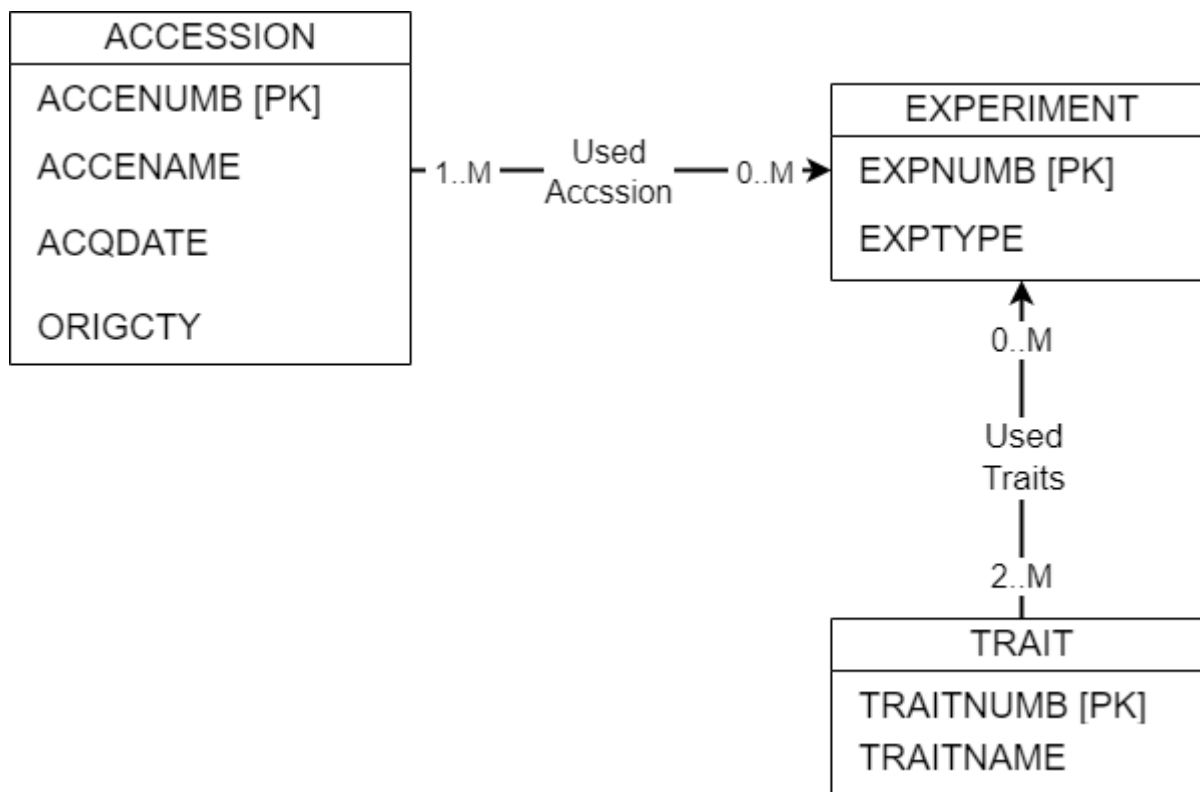
Detailed document for plant phenotyping experiments

UML Class diagram | SQL Schema | REST API Implementation and testing

BY

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UML class diagram:



Entities:

As mentioned in the problem entities ACCESSION, EXPERIMENT and TRAIT.

Attributes:

Based on my research, MCPD V.2.1 which was released in 2012, to improve the maintainability with current database adopted the same nomenclature to all attributes such as Accession id as ACCENUMB, Country of origin as ORIGCTY and TRAIT id as TRAITNUMB.

Relations:

- Experiment may have one to many Accessions.
- Accession may use in zero or many experiments.
- Experiment involved two to many traits.
- Trait may use in zero or many experiments.

Keys:

Primary keys represented with [PK] notation.

SQL Schema:

```
drop table if exists accession cascade;
drop table if exists experiment cascade;
drop table if exists trait cascade;
drop table if exists experiments_traits cascade;

create table accession
(
    acce_numb varchar(8) not null,
    accession_name varchar(255) not null,
    acquisition_date varchar(255) not null,
    origin_country smallint not null,
    primary key (acce_numb)
);

create table experiment
(
    exp_numb varchar(9) not null,
    exp_type varchar(255) not null,
    acce_numb varchar(255), primary key (exp_numb)
);

create table experiments_traits
(
    exp_numb varchar(255) not null,
    trait_numb varchar(255) not null
);

create table trait
(
    trait_numb varchar(8) not null,
    trait_name varchar(255) not null,
    primary key (trait_numb)
);

alter table if exists trait add constraint unique_trait_name unique (trait_name);

alter table if exists experiment add constraint fk_exp_acce_numb foreign key
(acce_numb) references accession;

alter table if exists experiments_traits add constraint fk_et_trait_numb foreign
key (trait_numb) references trait;

alter table if exists experiments_traits add constraint fk_et_exp_numb foreign
key (exp_numb) references experiment;
```

Validations implemented in Java:

Attribute	Validations	Accepted values	Stored as
acceNumb	should be 8 characters length and first 2 or 3 characters should be alphabets and remaining are digits.	ACC12345 PI987654	ACC12345 PI987654
accession_name	Names separated by semicolon (;) without spaces and first letter in uppercase.	Name1;Name2;name3 Name1; Name2 ; name3 Name1 Name ; name1 ; name1;	Name1;Name2;Name3 Name1;Name2;Name3 Name1; Name1; Name1; Name1;
acquisition_date	YYYY is the year, MM is the month and DD is the day. Missing data (MM or DD) should be indicated '00' [double zero].	20221231 20220000 20221200 20220031	20221231 20220000 20221200 20220031
origin_country	Accepts 3characters country code. Note: reads and displays in ISO_3166-1_alpha-3 code but stored as ISO_3166-1_numeric	USA Usa usa USa uSa	840 840 840 840 840
exp_numb	should be 9 characters length and first 3 characters should be alphabets and remaining are digits.	EXP123456	EXP123456
exp_type	Only two values accepted and in upper case.	FIELD GREENHOUSE	FIELD GREENHOUSE
trait_numb	should be 8 characters length and first 3 characters should be alphabets and remaining are digits.	TRT12345	TRT12345
trait_name	Should be unique		

Rest mapping

Method	URL	Action
GET	/ {tableName} /get/all	Retrieve all rows from the selected table.
GET	/ {tableName} /get/{id}	Retrieve selected row from selected table.
POST	/ {tableName} /put	Insert a record into the selected table.

JSON body to send in POST method:

Table name	URL	Example JSON body	Response
Accession	/accession/put	<pre>{ "acceNumb": "ACC38096", "acceName": "Name1; name2 ", "acqDate": "20220100", "origCty": "AFG" }</pre>	200 - Accession record inserted

Experiment	/experiment/put	<pre>{ "expNumb": "EXP341238", "expType": "FIELD", "traits":[{ "traitNumb": "TRT23456" }, { "traitNumb": "TRT28457" }, { "traitNumb": "TRT87497" }] }</pre>	200 - Experiment record inserted
Trait	/trait/put	<pre>{ "traitNumb": "TRT23396", "traitName": "Seed weight" }</pre>	200 - Trait record inserted

Testing REST endpoints in ACCESSION table:

- Retrieve all accessions:

The image shows a REST client interface with a 'DRAFT' label in the top left. In the top right, there is a 'Save as' button with a dropdown arrow. The main area is divided into sections: 'METHOD' with a dropdown set to 'GET', a URL field containing 'http://localhost:8080/accession/get/all', and a 'Send' button with a paper plane icon. Below the URL, it says 'length: 39 byte(s)'. A 'QUERY PARAMETERS' section is collapsed with a downward arrow and contains an 'Add query parameter' button. At the bottom, there are tabs for 'HEADERS' and 'BODY'. The 'HEADERS' tab is active, showing 'Add header' and 'Add authorization' buttons. The 'BODY' tab is also visible, showing a message: 'XHR does not allow payloads for GET request.'

Figure 1: Request to retrieve all accessions.

Response

200

HEADERS ⓘ

Content-Type: application/json
Transfer-Encod... chunked
Date: Fri, 31 Mar 2023 12:30:26 GMT
Keep-Alive: timeout=60
Connection: keep-alive

▶ COMPLETE REQUEST HEADERS

pretty ▼

BODY ⓘ

```
[
  {
    acceNumb: "ACC72834",
    acceName: "Brazilian;Lime;Janu",
    acqDate: "20200301",
    origCty: "USA",
    experiments: [
      {
        expNumb: "EXP356238",
        expType: "FIELD",
        traits: [ {traitNumb: "TRT23456", traitName: "height of tree" }, {traitNumb: "TRT87497",...} ],
      },
      {
        expNumb: "EXP896152",
        expType: "GREENHOUSE",
        traits: [ {traitNumb: "TRT23456", traitName: "height of tree" }, {traitNumb: "TRT93457",...} ]
      }
    ]
  },
  {
    acceNumb: "ACC90786",
    acceName: "Indian;Mango",
    acqDate: "20210300",
    origCty: "IND",
    experiments: [
      {
        expNumb: "EXP751682",
        expType: "GREENHOUSE",
        traits: [ {traitNumb: "TRT28457", traitName: "flowering season" }, {traitNumb: "TRT87497",...} ]
      }
    ]
  }
]
```

Figure 2: JSON response to retrieve all accessions request

- Retrieve selected accession:

The screenshot shows a web client interface with a 'DRAFT' label in the top left corner. In the top right, there is a 'Save as' button with a dropdown arrow. The main interface is divided into two sections: 'HEADERS' on the left and 'BODY' on the right, separated by a vertical line. The 'HEADERS' section has a 'Form' dropdown and a '+ Add header' button. Below it is a link icon and the text 'Add authorization'. The 'BODY' section has a question mark icon and the text 'XHR does not allow payloads for GET request.' The top of the interface contains a 'METHOD' dropdown set to 'GET' and a text input field with the URL 'http://localhost:8080/accession/get/ACC72834'. To the right of the URL is a 'Send' button with a paper plane icon and a dropdown arrow. Below the URL, there is a 'QUERY PARAMETERS' section with a '+ Add query parameter' button. The text 'length: 44 byte(s)' is displayed to the right of the URL field.

Figure 3: Requesting accession by id

Response

Cache Detected - Elapsed Time: 3ms

200

HEADERS ⓘ

pretty ▾

Content-Type: application/json
Transfer-Encoding: chunked
Date: Fri, 31 Mar 2023 12:42:36 GMT
Keep-Alive: timeout=60
Connection: keep-alive

▶ COMPLETE REQUEST HEADERS

BODY ⓘ

pretty ▾

```
{
  "acceNumb": "ACC72834",
  "acceName": "Brazilian;Lime;Janu",
  "acqDate": "20200301",
  "origCty": "USA",
  "experiments": [
    {
      "expNumb": "EXP356238",
      "expType": "FIELD",
      "traits": [
        { "traitNumb": "TRT23456", "traitName": "height of tree" },
        { "traitNumb": "TRT87497", "traitName": "seed weight" }
      ]
    },
    {
      "expNumb": "EXP896152",
      "expType": "GREENHOUSE",
      "traits": [
        { "traitNumb": "TRT23456", "traitName": "height of tree" },
        { "traitNumb": "TRT93457", "traitName": "leaf shape" }
      ]
    }
  ]
}
```

lines nums copy

length: 420 bytes

Figure 4: JSON response to the request accession (ACC72834)

- Creating new accession

The screenshot shows a REST client interface with a 'DRAFT' label in the top left. The top right has a 'Save as' button. The main area is divided into sections for request configuration:

- METHOD:** A dropdown menu set to 'POST'.
- URL:** A text field containing 'http://localhost:8080/accession/put' with a 'length: 35 byte(s)' indicator.
- QUERY PARAMETERS:** A section with a '+ Add query parameter' button.
- HEADERS:** A section with a 'Form' dropdown, a checked 'Content-Type' header set to 'application/json', and buttons for '+ Add header', 'Add authorization', and a delete icon.
- BODY:** A section with a 'Text' dropdown and a code editor containing a JSON object:

```
1 {  
2   "acceNumb": "ACC73534",  
3   "acceName": "Name1 ; name2 ; name3  ",  
4   "acqDate": "20210200",  
5   "origCty": "IND"  
6 }  
7
```

At the bottom right, there are options for 'Text', 'JSON', 'XML', 'HTML', a 'Format body' button, a checked 'Enable body evaluation' checkbox, and a 'length: 115 bytes' indicator.

Figure 5: Sending JSON body using POST method to insert accession

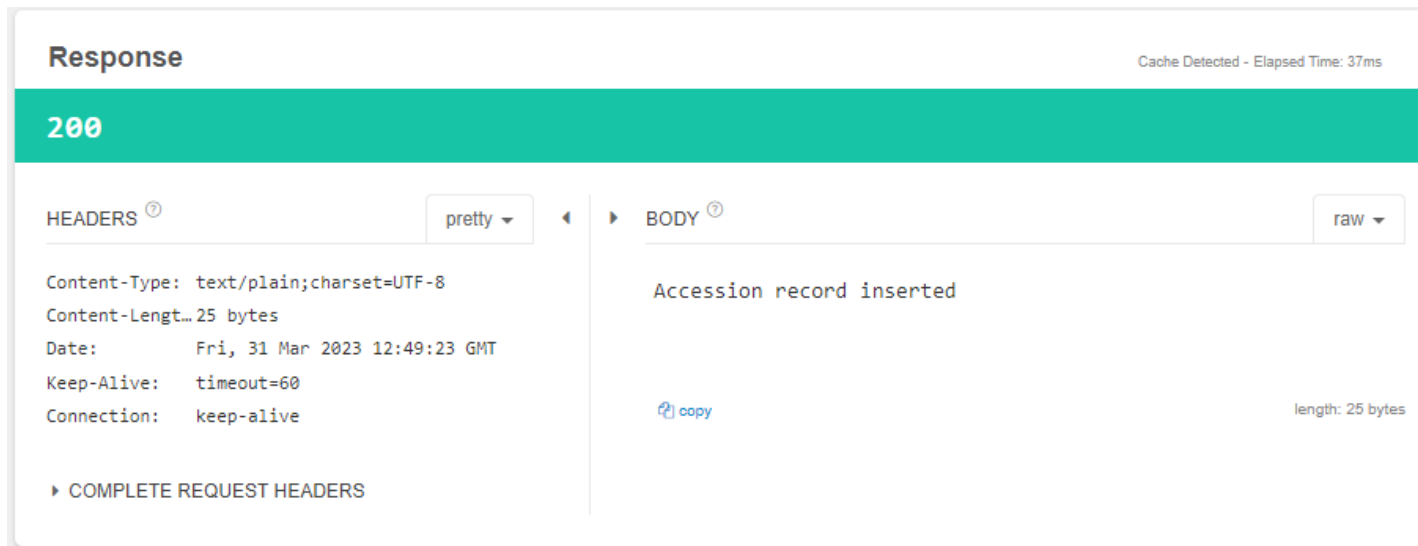


Figure 6: Response to the insertion of accession (ACC73534)

- **Retrieving Accession (ACC73534)**

DRAFT

Save as

METHOD: GET | SCHEME :// HOST [":" PORT] [PATH ["?" QUERY]] | length: 44 byte(s)

Send

QUERY PARAMETERS

+ Add query parameter

HEADERS | Form | BODY

+ Add header | Add authorization

XHR does not allow payloads for GET request.

Response | Cache Detected - Elapsed Time: 1ms

200

HEADERS | pretty | BODY | pretty

Content-Type: application/json
Transfer-Enco... chunked
Date: Fri, 31 Mar 2023 12:50:48 GMT
Keep-Alive: timeout=60
Connection: keep-alive

▶ COMPLETE REQUEST HEADERS

```
{
  acceNumb: "ACC73534",
  acceName: "Name1;Name2;Name3",
  acqDate: "20210200",
  origCty: "IND",
  experiments: []
}
```

lines nums | copy | length: 108 bytes

Figure 7: Response to the retrieval request of accession (ACC73534)