Visualization of Inferred Versioned Schemas from NoSQL Databases

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About the authors

- Member of the Cátedra SAES team since 2014
- M.Sc. in Computer Science from the UM
- MDE, automatic code generation, NoSQL databases

- Associate professor at the Faculty of Computer Science of the UM
- M.Sc and Ph.D. in Computer Science from the UM
- NoSQL databases, distributed systems, testing

- Professor at the Faculty of Computer Science of the UM since 1984
- Head of the Modelum Group
- MDE, DSL, Software modernization, reverse engineering

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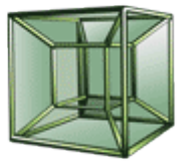
Introduction and context

NoSQL systems



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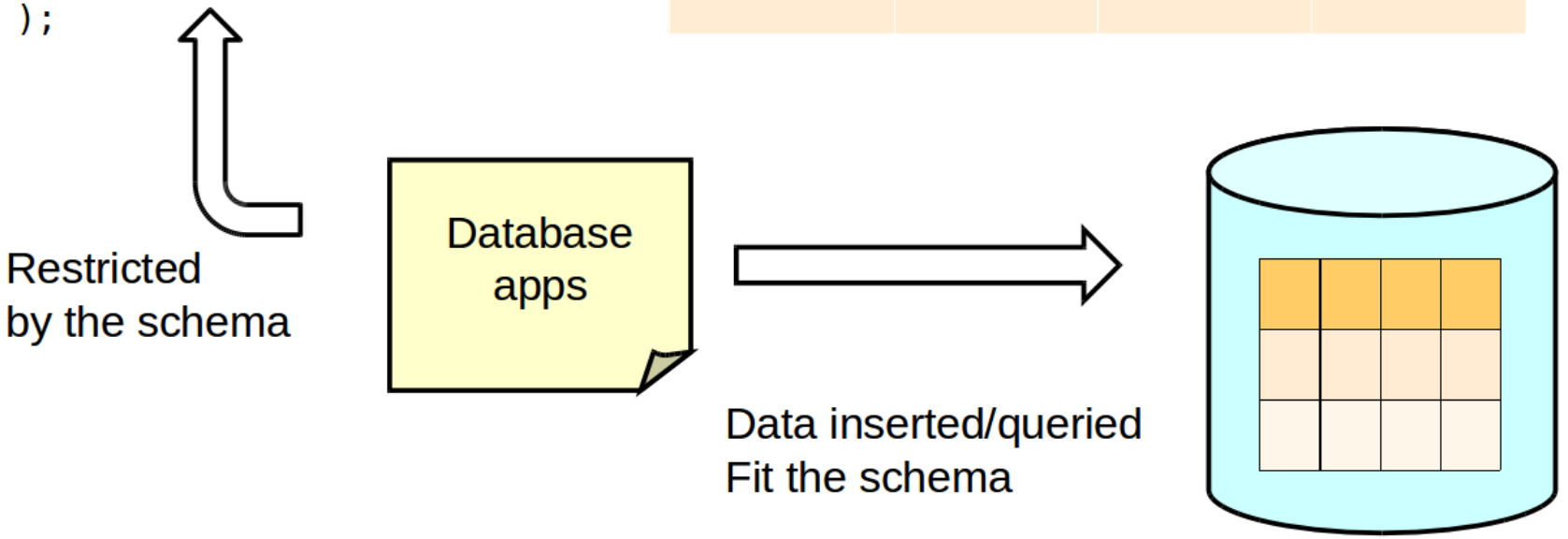
Usefulness of an explicit schema

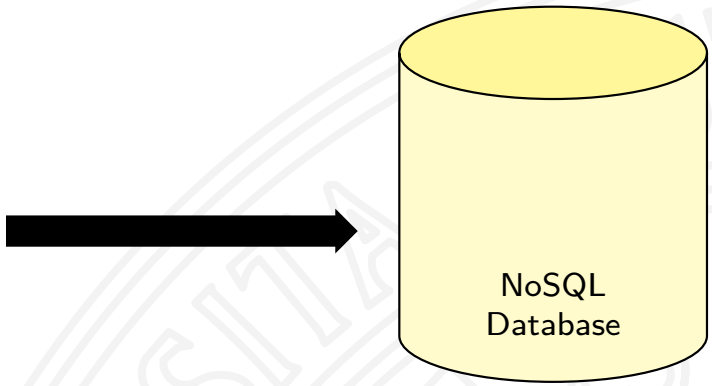
```
CREATE TABLE Persons (
  PersonID int,
  LastName varchar(255),
  FirstName varchar(255),
  Address varchar(255)
);
```

PersonID	LastName	FirstName	Address



What kind of NoSQL systems? - Schemaless

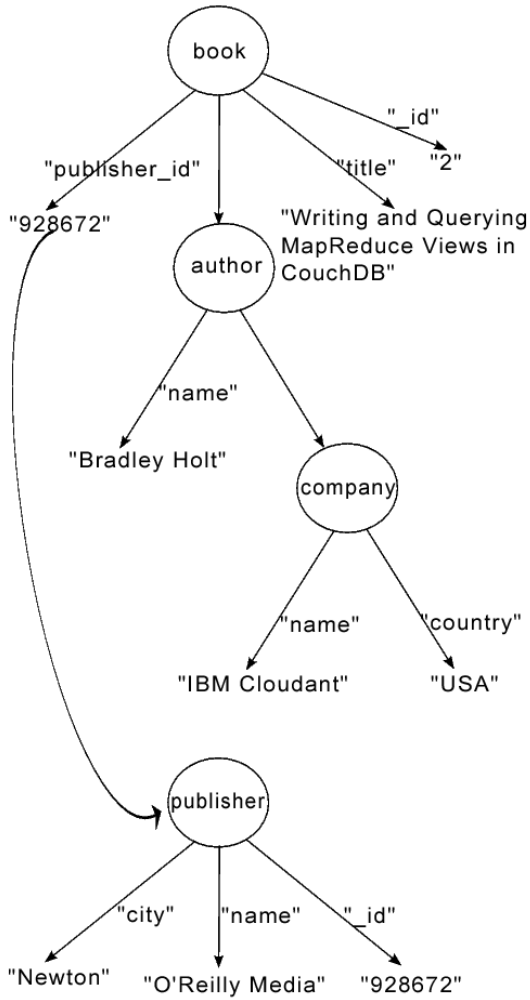
```
{
  "person_id": "123",
  "type": "Person",
  "lastName": "Rush",
  "firstName": "Christopher",
  "address": "C/Gran Via, 13, Madrid"
},
{
  "person_id": "456",
  "type": "Person",
  "lastName": "England",
  "firstName": "Wayne",
  "address": {
    "street": "Av. Pinos, 24",
    "city": "Murcia" }
},
{
  "person_id": "789",
  "type": "Person",
  "lastName": "Hoover",
  "firstName": "Quinton",
  "address": "Ronda Norte, 15, Murcia",
  "age": 35
}
```



- Data non-uniformity
- Different versions for the same data

What kind of NoSQL systems? - Aggregations

```
{
  "_id": "2",
  "type": "book",
  "title": "Writing and Querying MapReduce
       Views in CouchDB",
  "publisher_id": "928672",
  "author":
  {
    "_id": "101",
    "type": "author",
    "name": "Bradley Holt",
    "company": {
      "_id": "324",
      "type": "company",
      "name": "IBM Cloudant",
      "country": "USA"}
  },
},
{
  "_id": "928672",
  "type": "publisher",
  "name": "O'Reilly Media",
  "city": "Newton"
}
```



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Proposed objective

- A *DataVersity* report (2015) indicated essential functionality required in the near future:
  - **Model visualization**
  - Code generation from schemas
  - Metadata management
- Our goal is to design and implement a tool which will allow us to visualize NoSQL schemas:
  - Taking into account concepts such as versions...
  - ...having in mind the underlying inference process...
  - ...among other things

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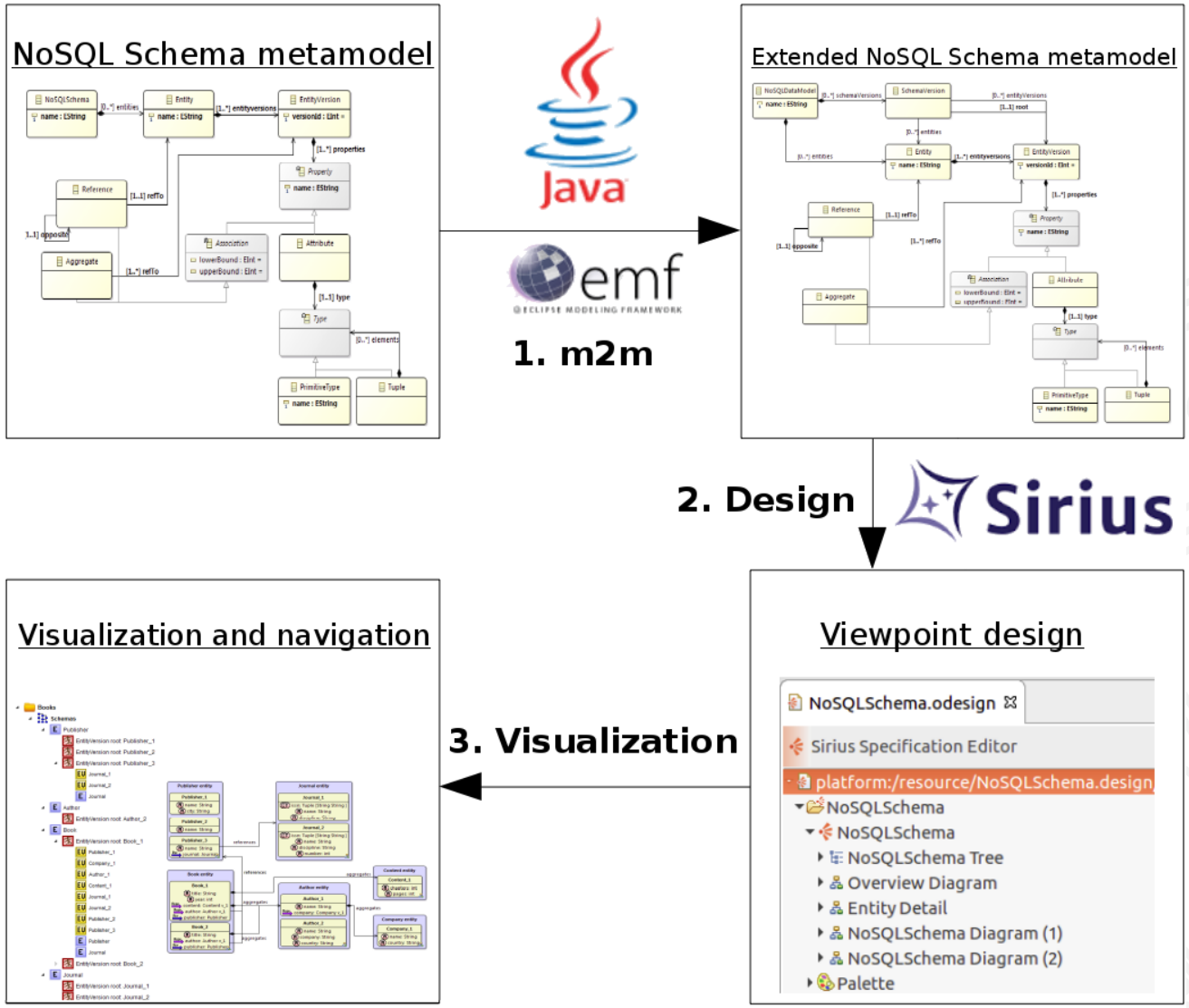
Process overview



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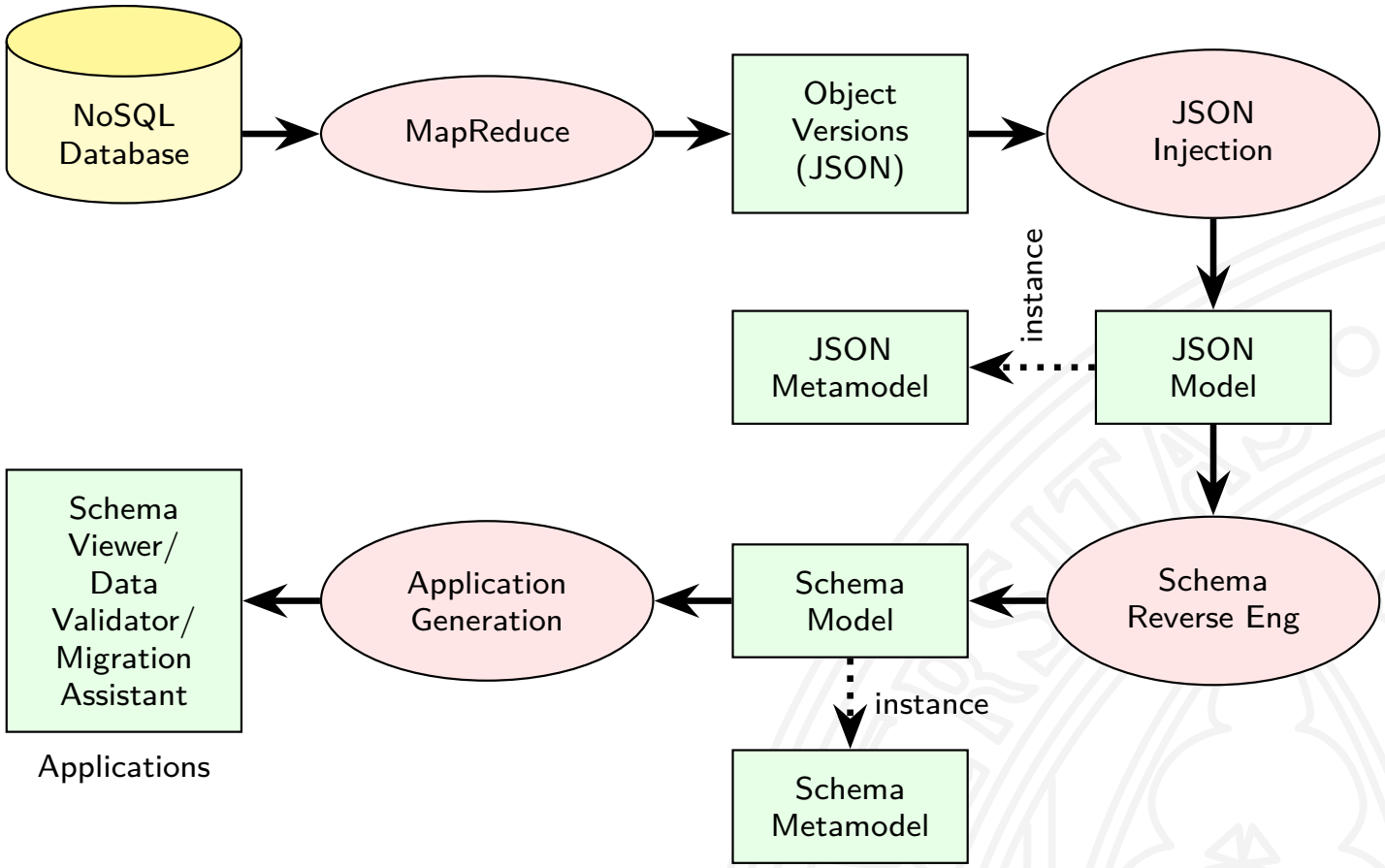
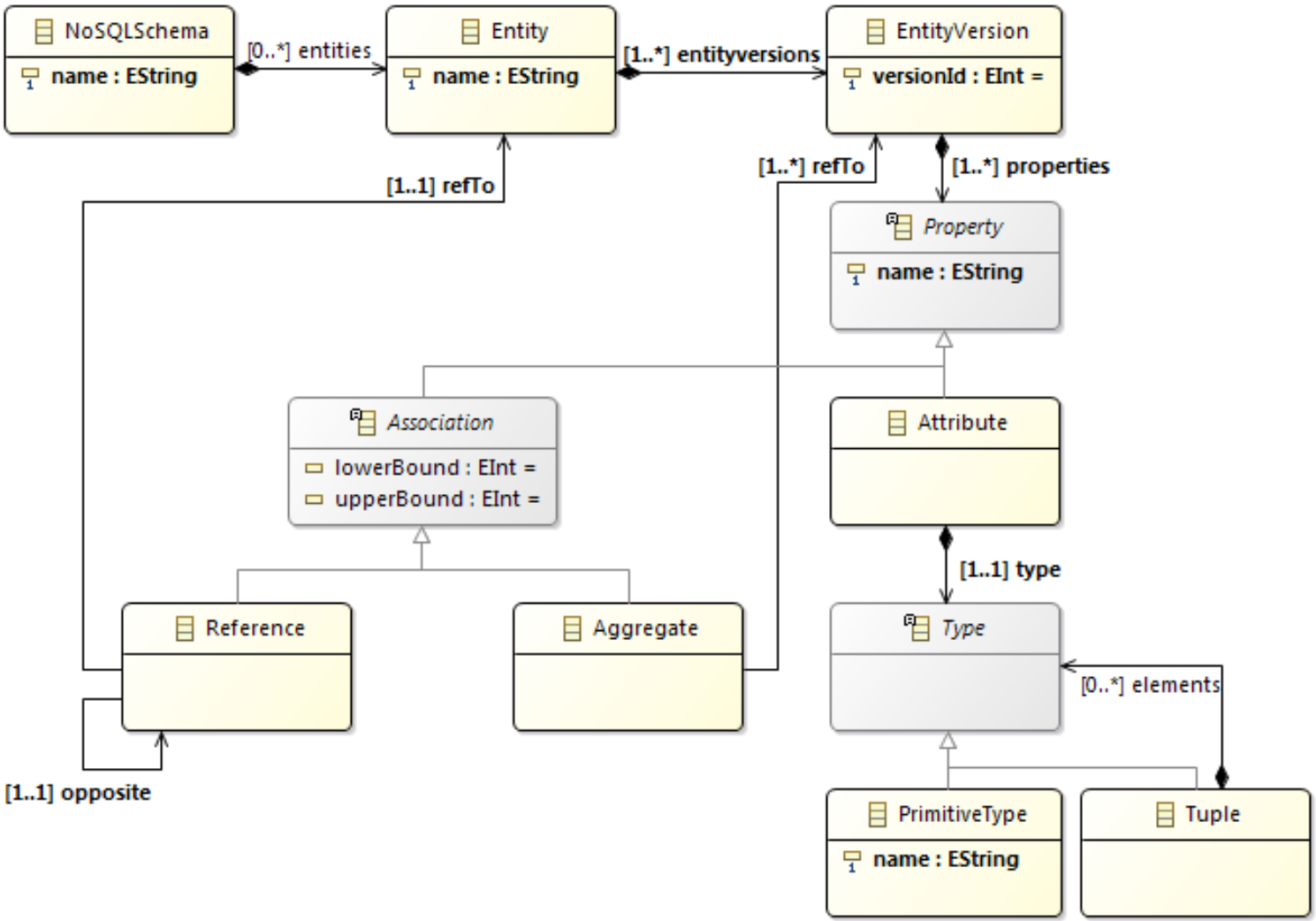
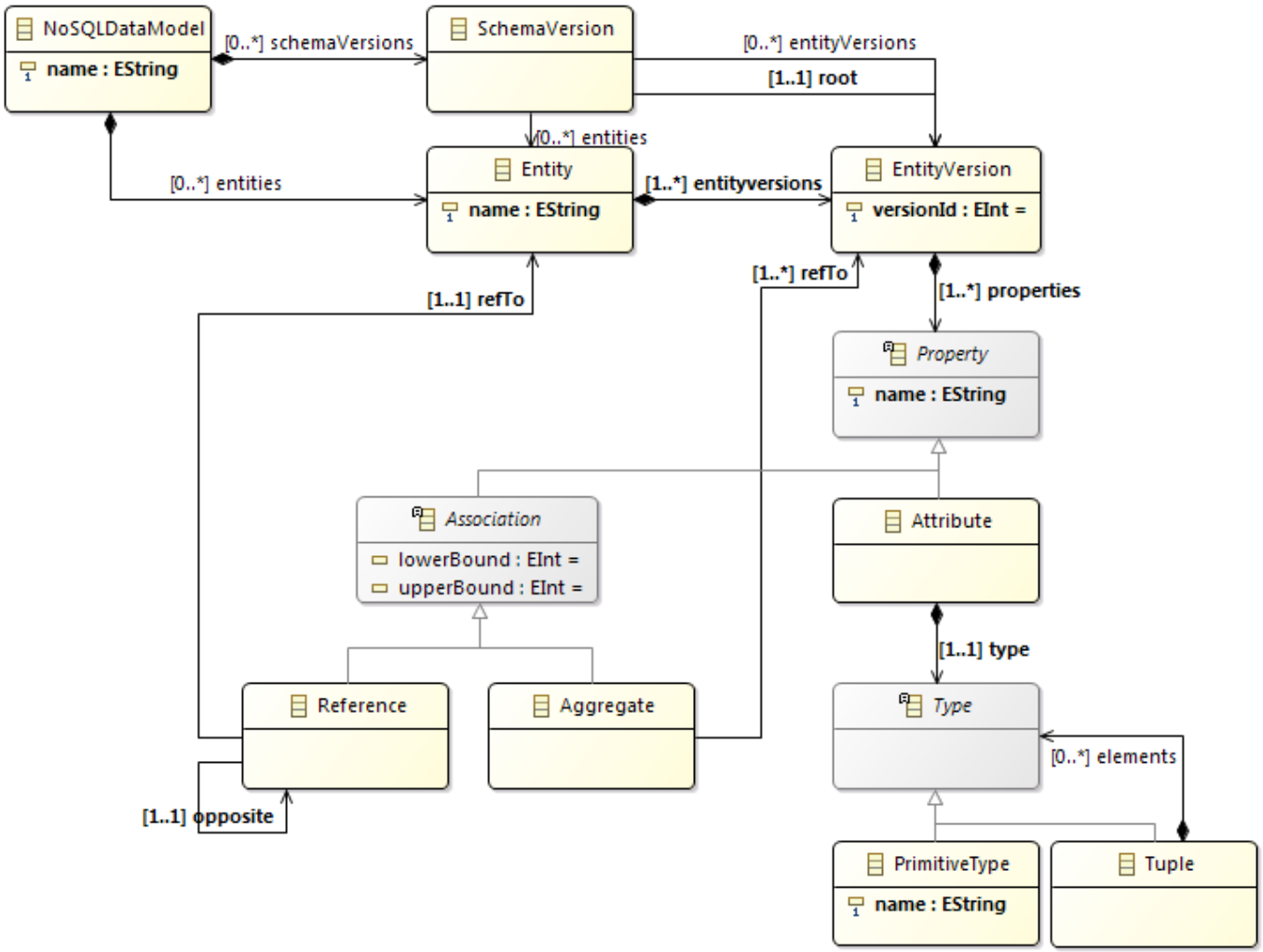
Inference process (I)



Initial metamodel



Polished metamodel (I)



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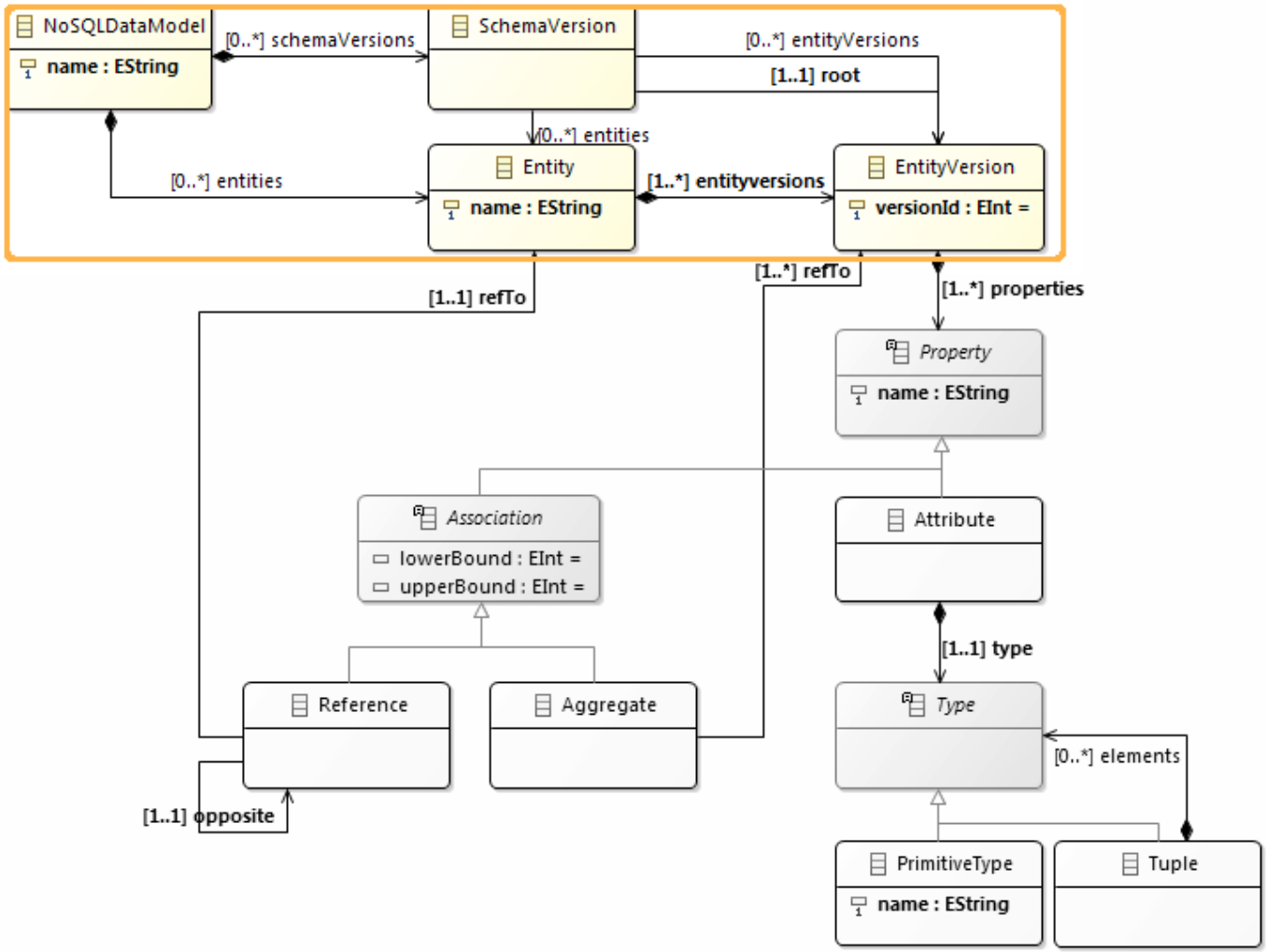
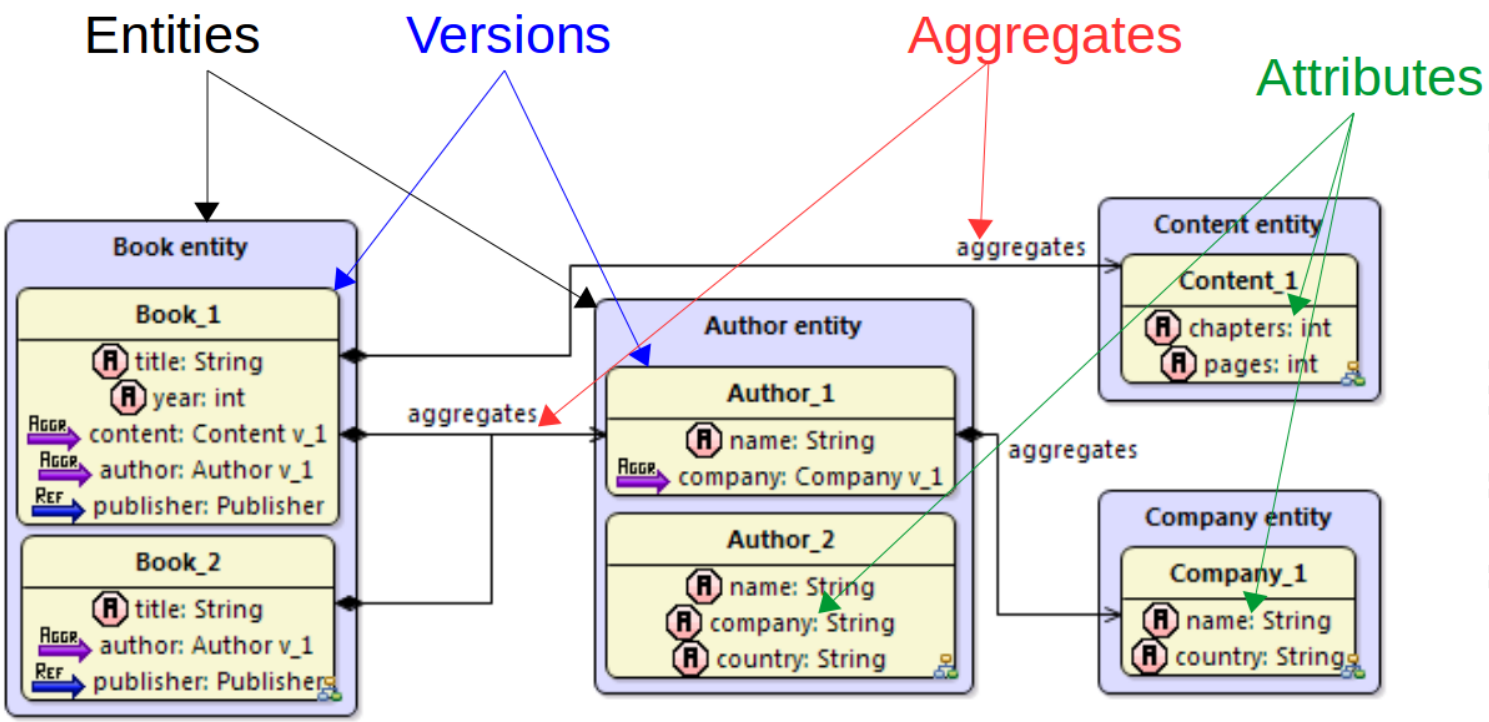
Polished metamodel (II)

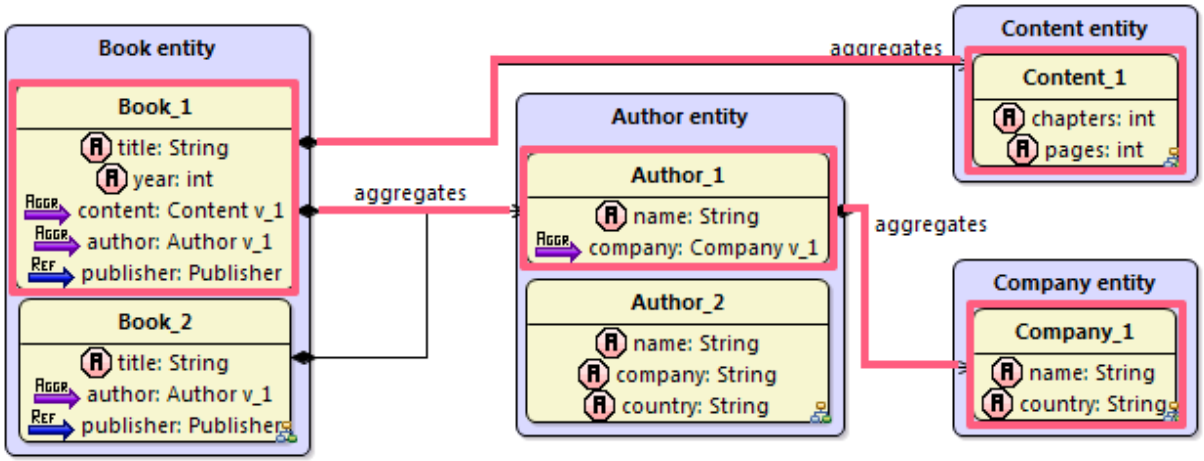


Metamodel elements



Schema versions (I)

Schema version for Book_1




```
...
{
  "_id": "53",
  "type": "Book",
  "title": "Book_1",
  "hasContent":
  [{
    "_id": "64",
    "type": "Content",
    "chapters": 3,
    "pages": 17
  }],
  "hasAuthors":
  [{
    "_id": "155",
    "type": "Author",
    "name": "Author_155",
    "hasCompany":
    [{
      "_id": "123",
      "type": "Company",
      "name": "Company_123",
      "country": "Country_1"
    }]
  }]
}
...
```

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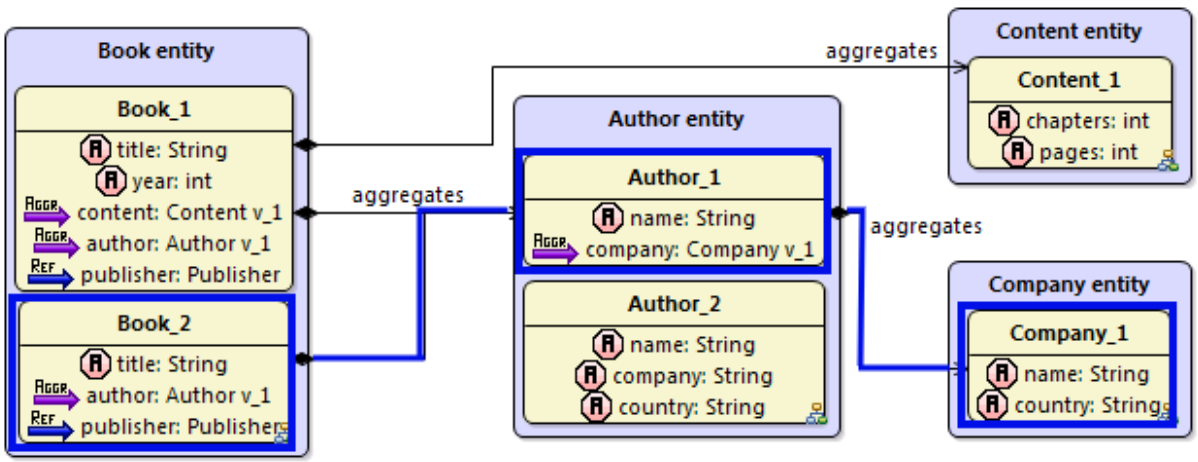
Schema versions (II)

Schema version for Book_2




```
...
{
  "_id": "89",
  "type": "Book",
  "title": "Book_2",
  "hasAuthors":
  [{
    "_id": "77",
    "type": "Author",
    "name": "Author_77",
    "hasCompany":
    [{
      "_id": "61",
      "type": "Company",
      "name": "Company_61",
      "country": "Country_2"
    }]
  }]
}
...
```

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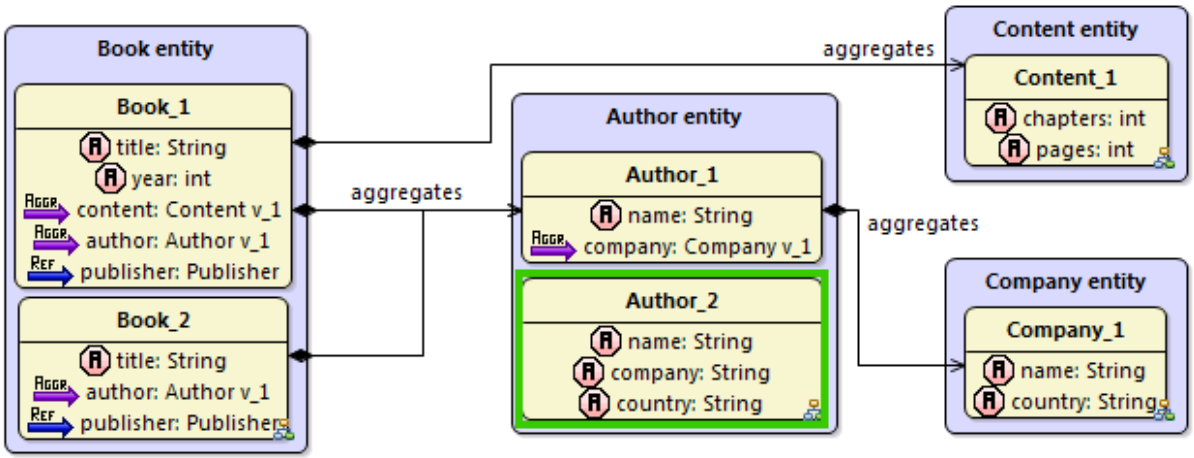
Schema versions (III)

Schema version for Author_2




```
...
{
   "_id": "99",
   "type": "Author",
   "name": "Author_2",
   "company": "Company_3",
   "country": "Country_3"
}
...
```

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Schema visualization

Why using Sirius?

- Views we need:
  - General tree view
  - Global schema view
  - Schema version views
  - Entity detail view
- Ability to create different viewpoints and navigability mechanisms between them
- Automatic generation of an embedded editor in the Eclipse environment
- Extensibility

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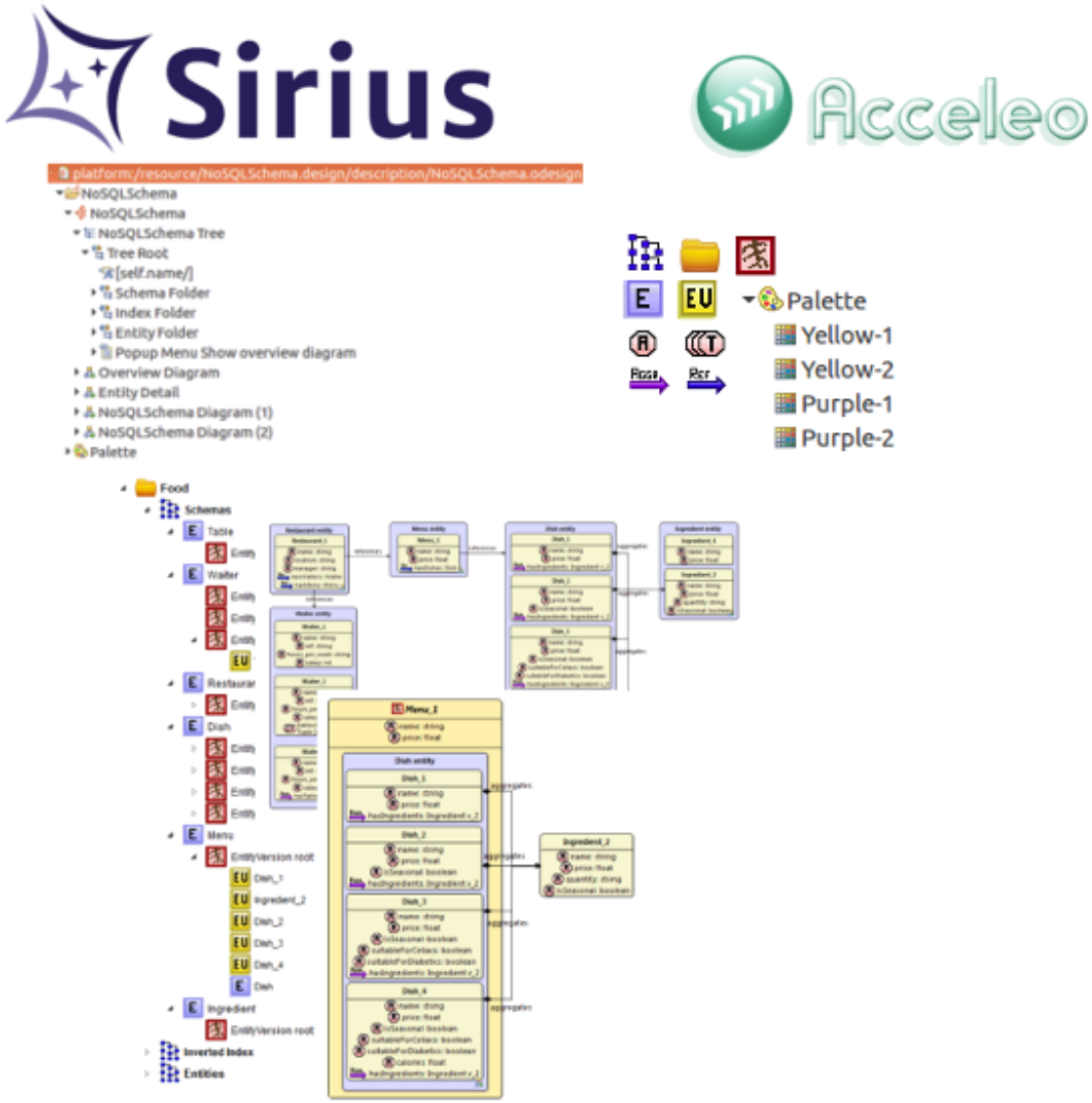
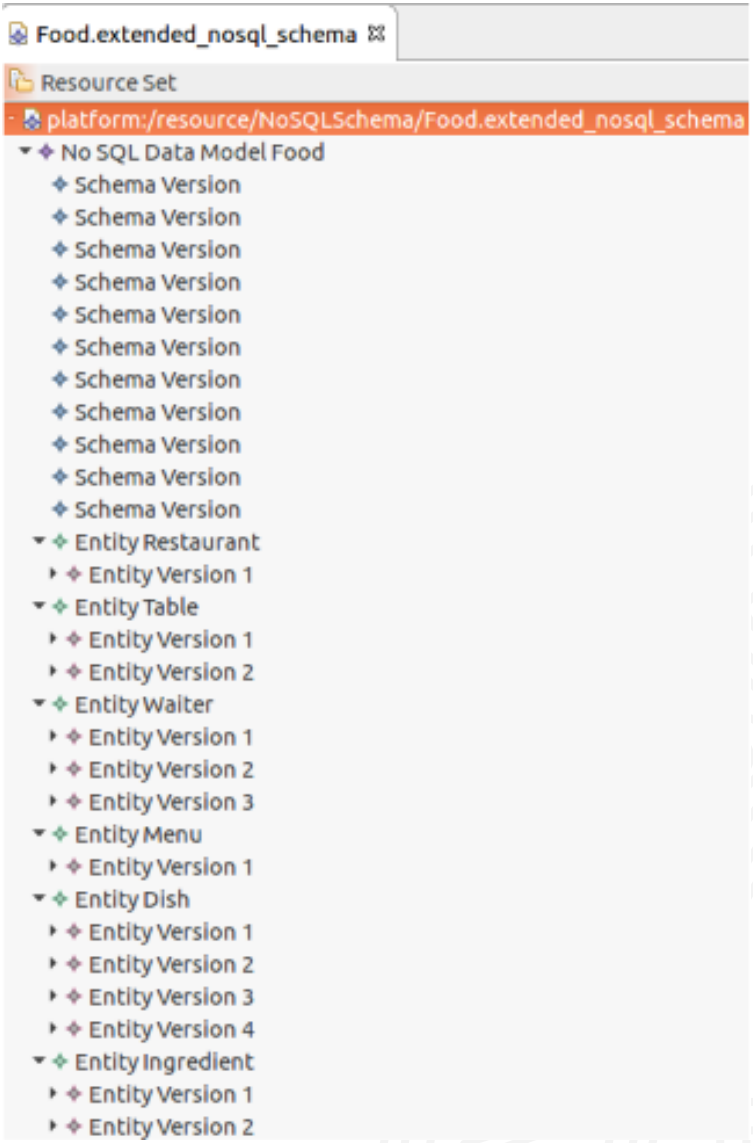
Design process



Schema visualization - Input model



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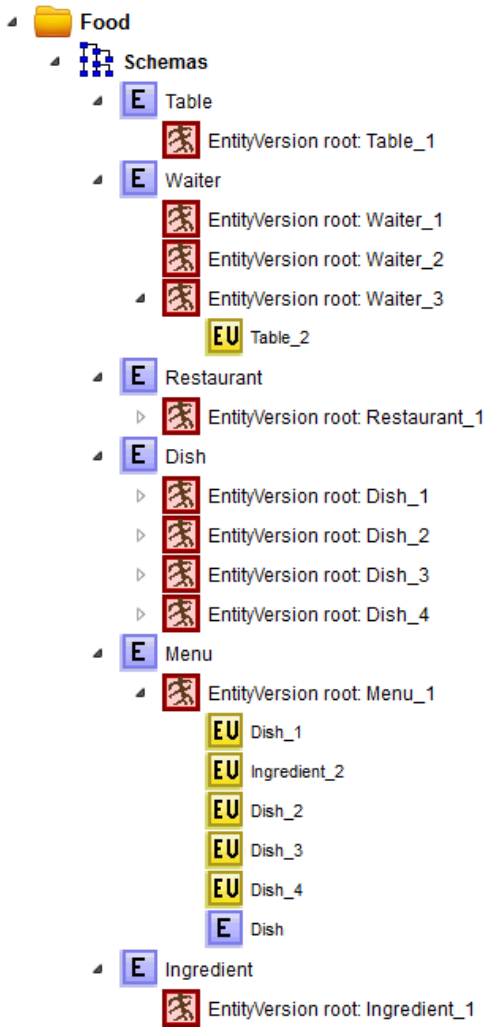
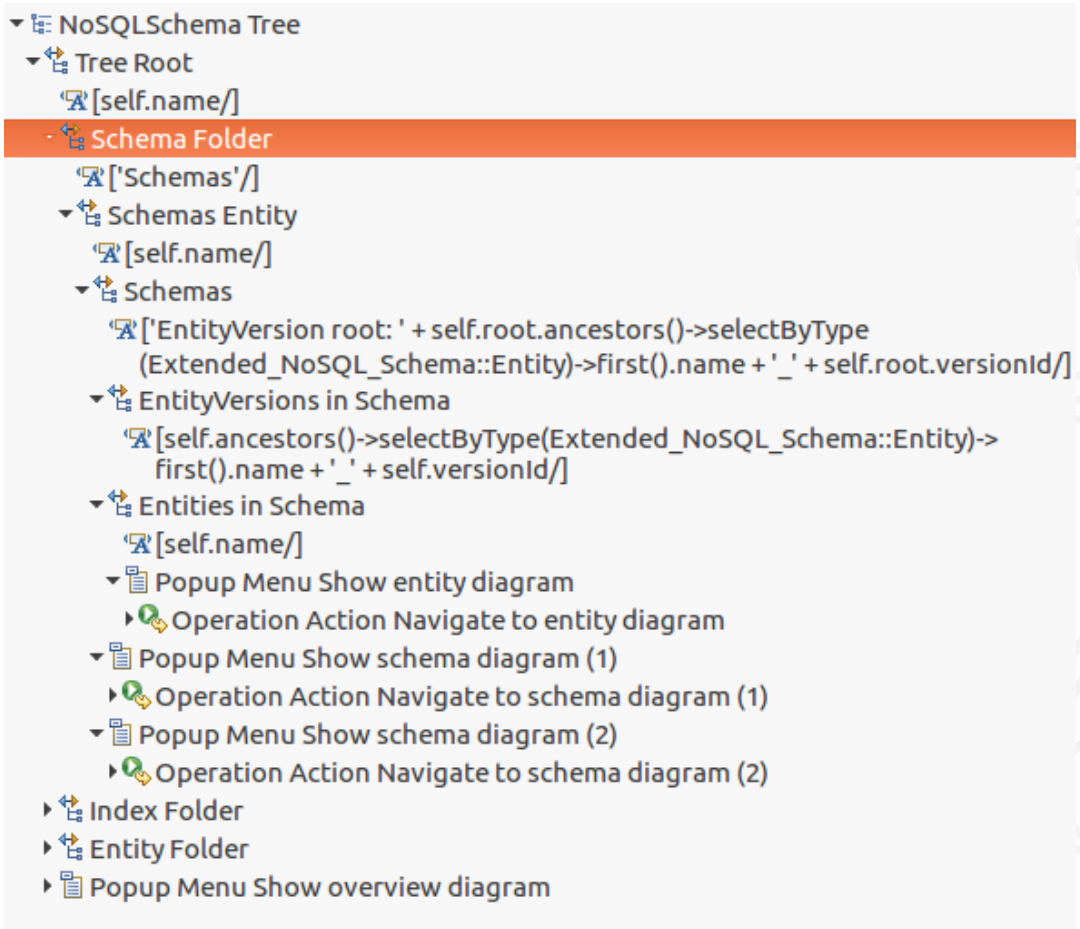
Schema visualization - Tree viewpoint (I)

Schema versions grouped by Entity





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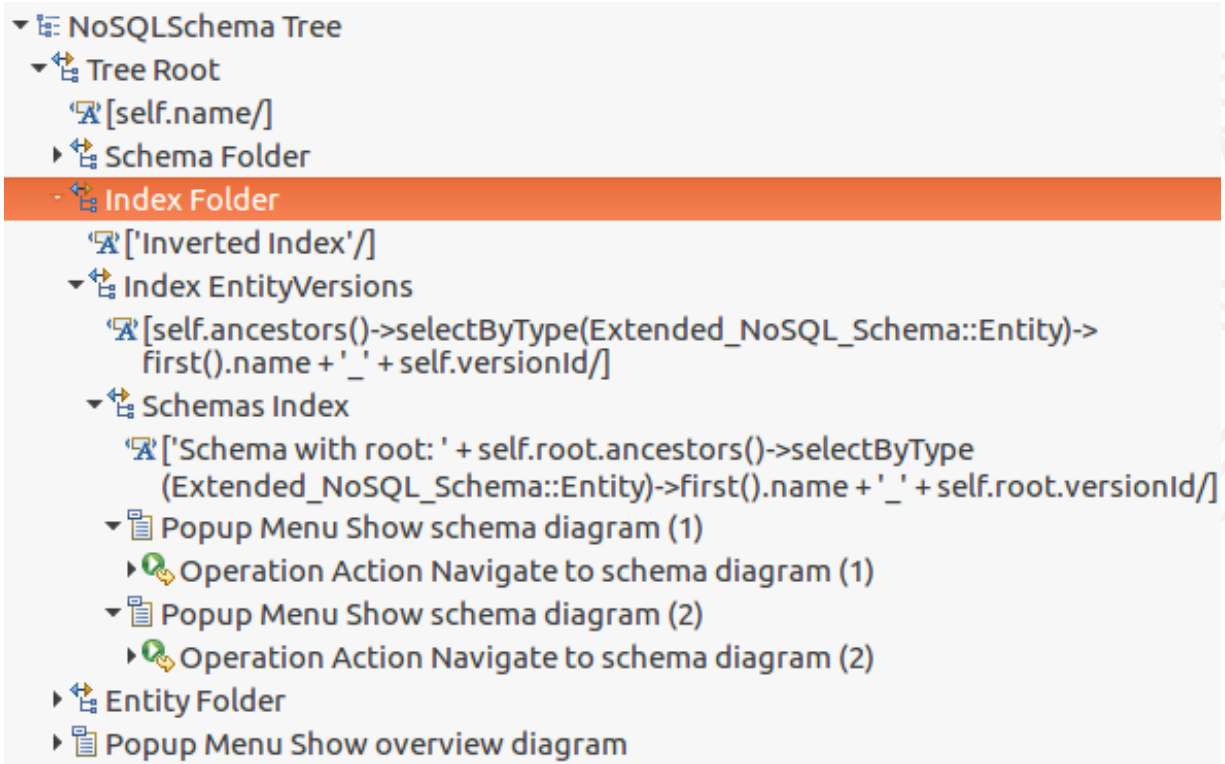
Schema visualization - Tree viewpoint (II)

Schema versions grouped by Version



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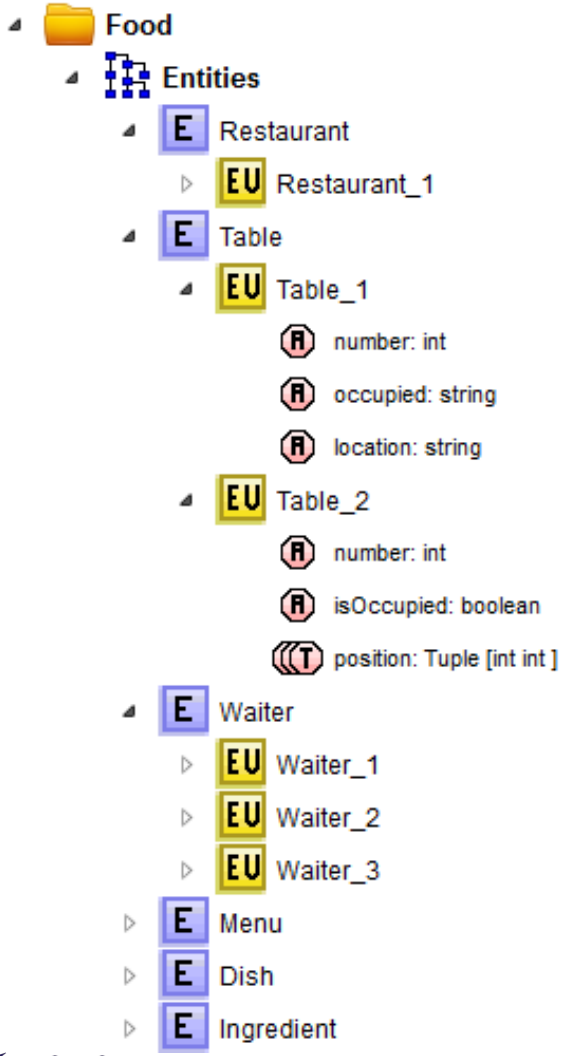
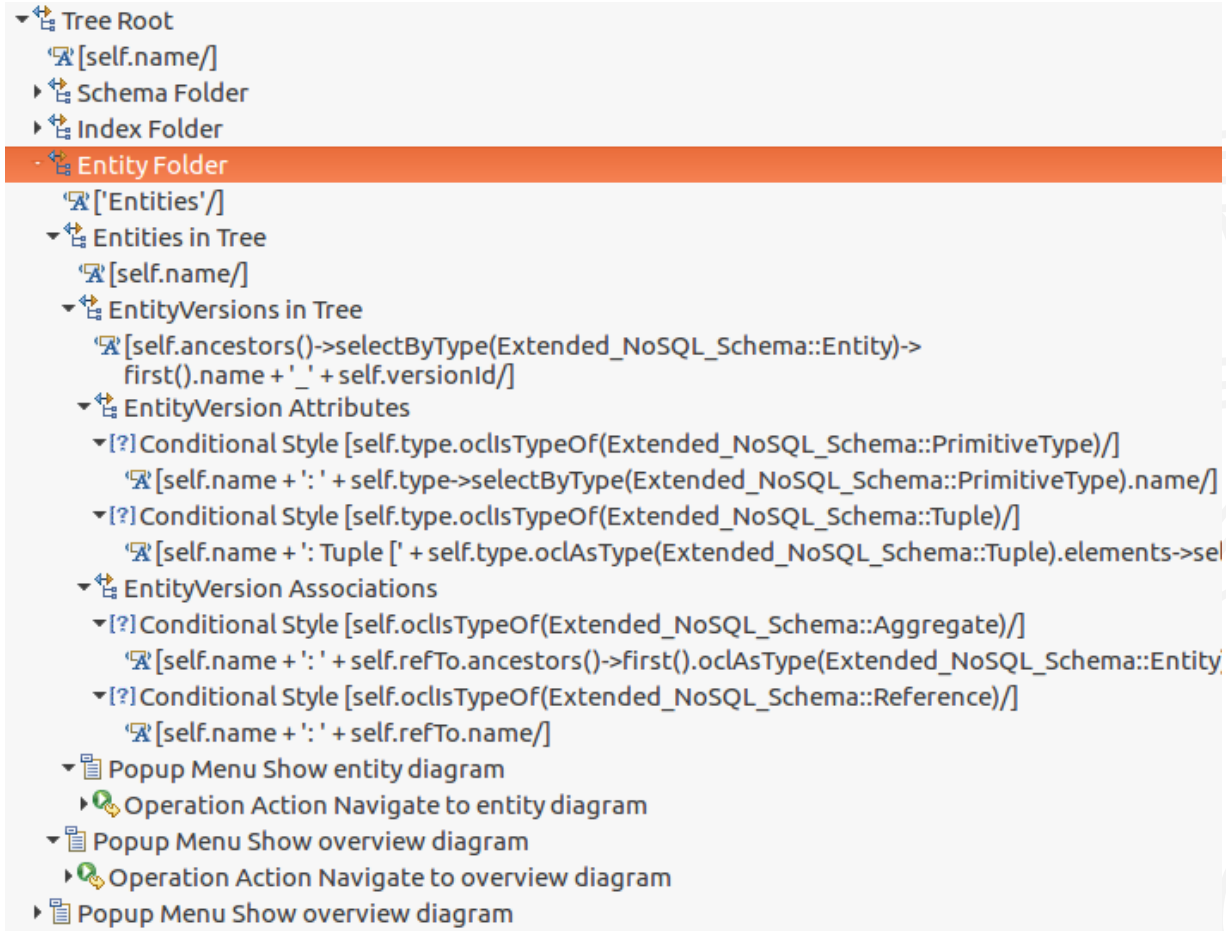
Schema visualization - Tree viewpoint (III)

List of Entities, Versions and Properties





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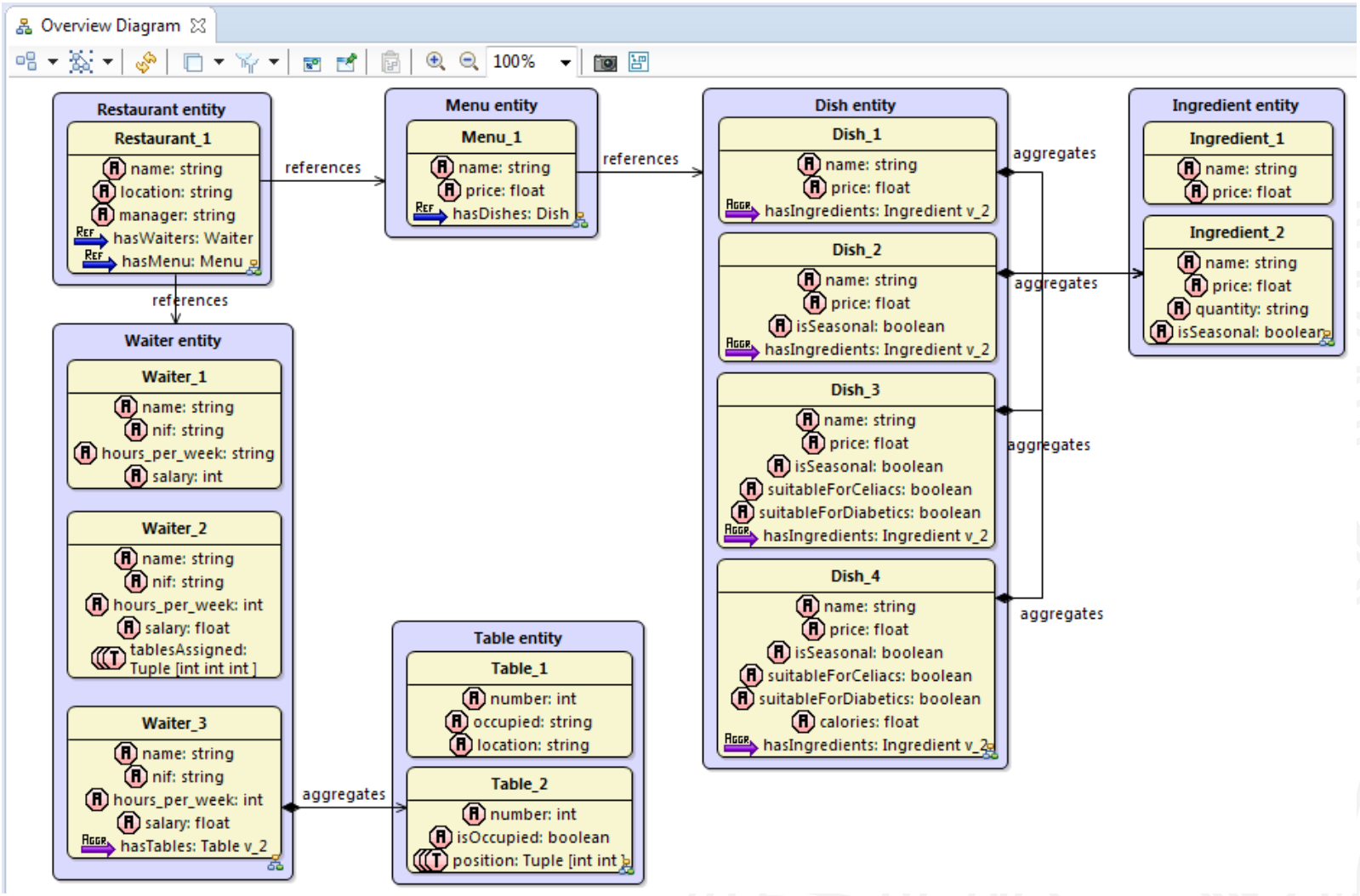
Schema visualization - Global schema (I)

Diagram of Entities, Versions and Properties



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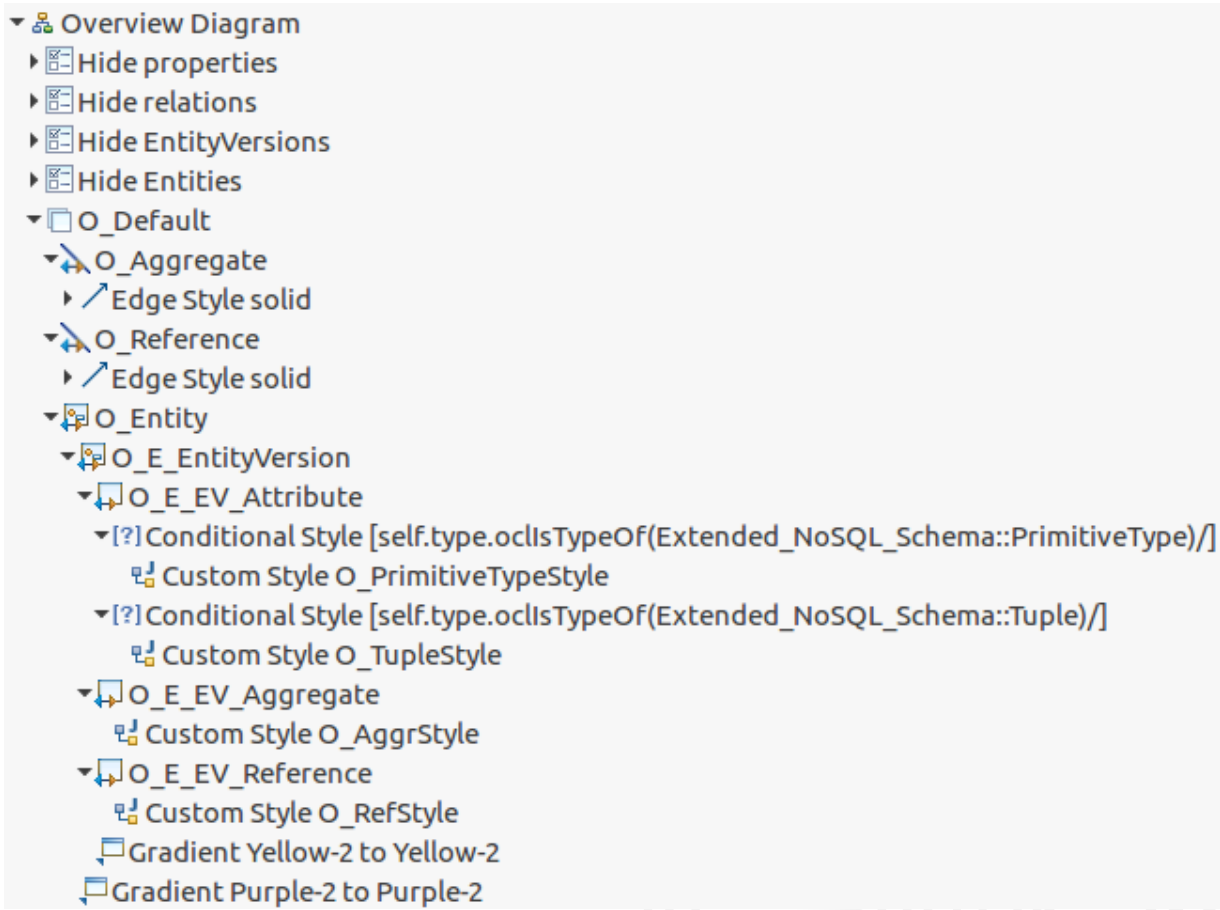
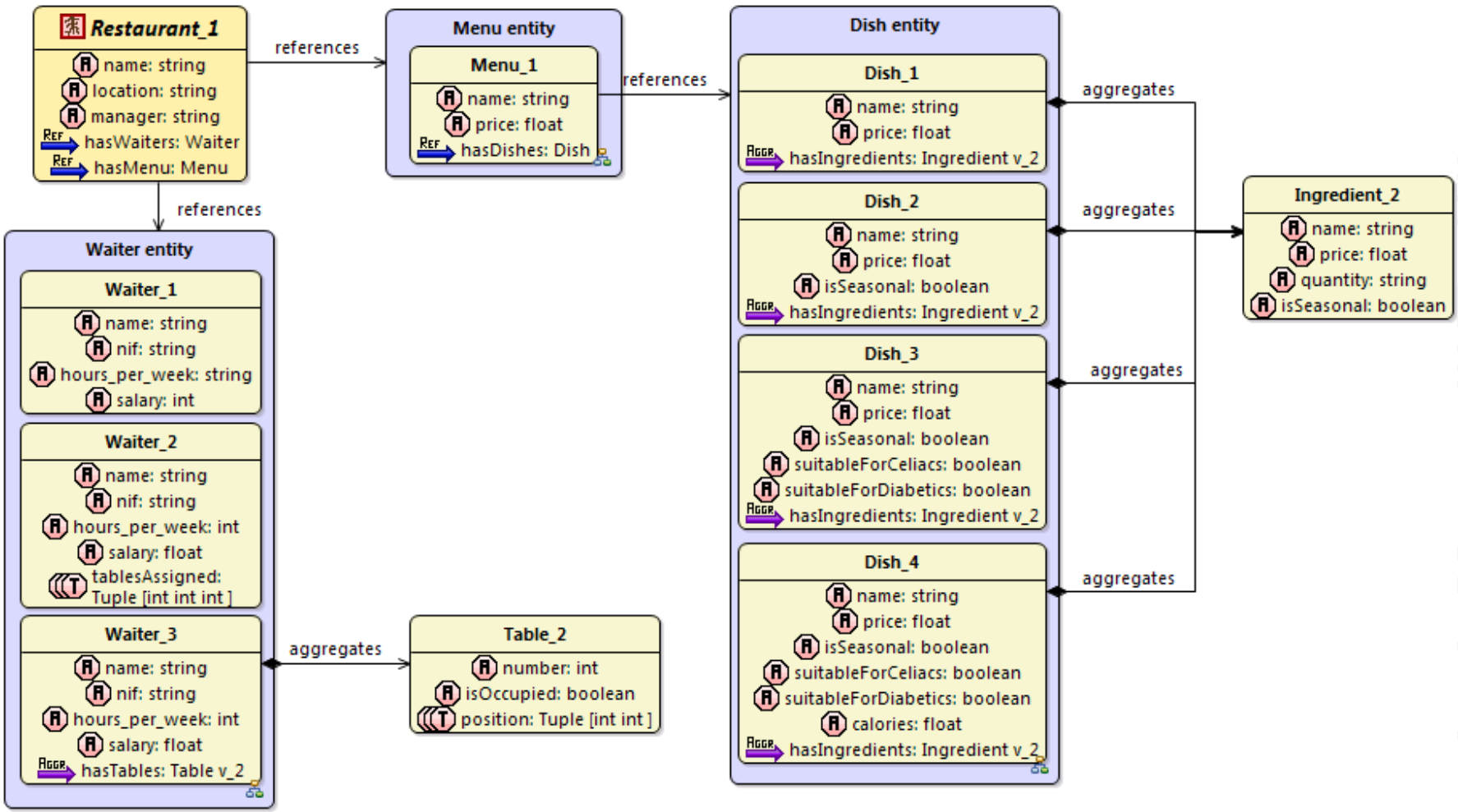
Schema visualization - Global schema (II)

Implementation of the Global schema



Schema visualization - Schema version (I)

Schema version root and its associations



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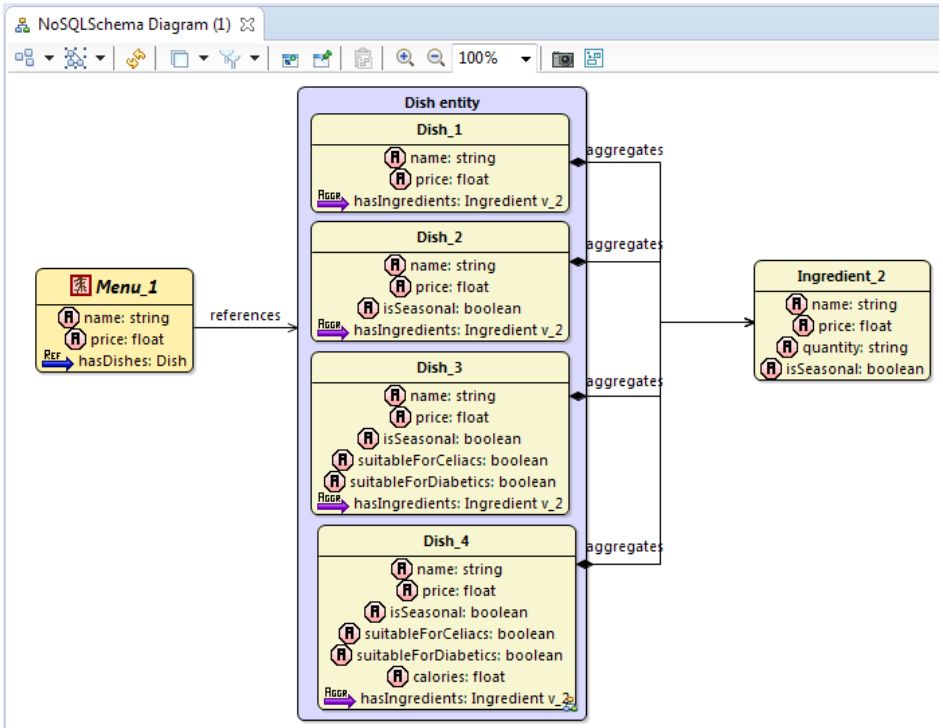
Schema visualization - Schema version (II)

Implementation of the Schema view



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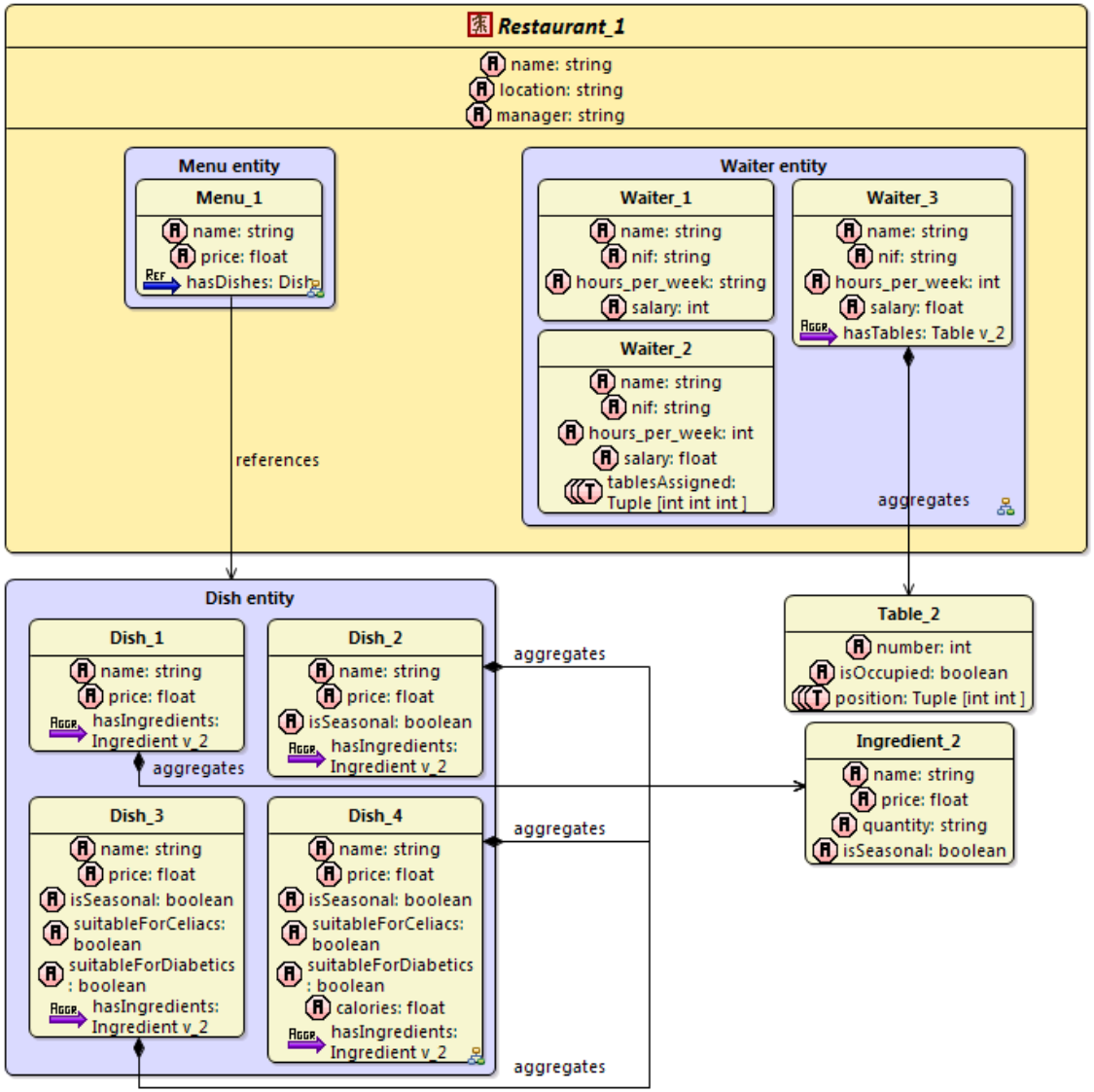
Schema visualization - Schema version (III)

Variation with embedded direct associations



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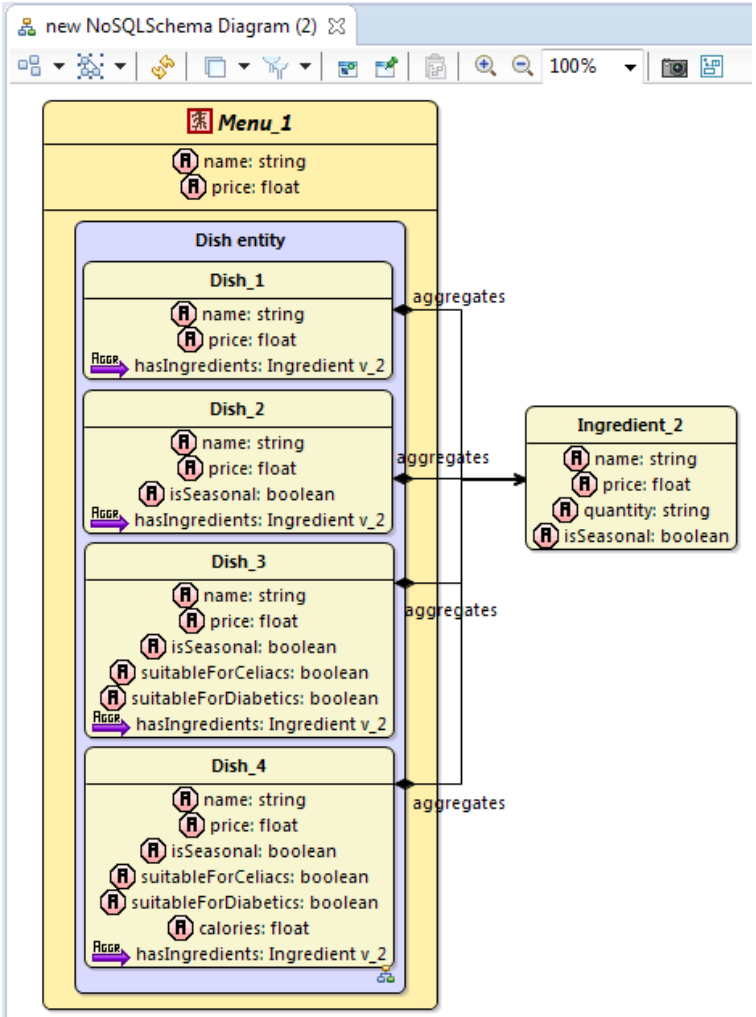
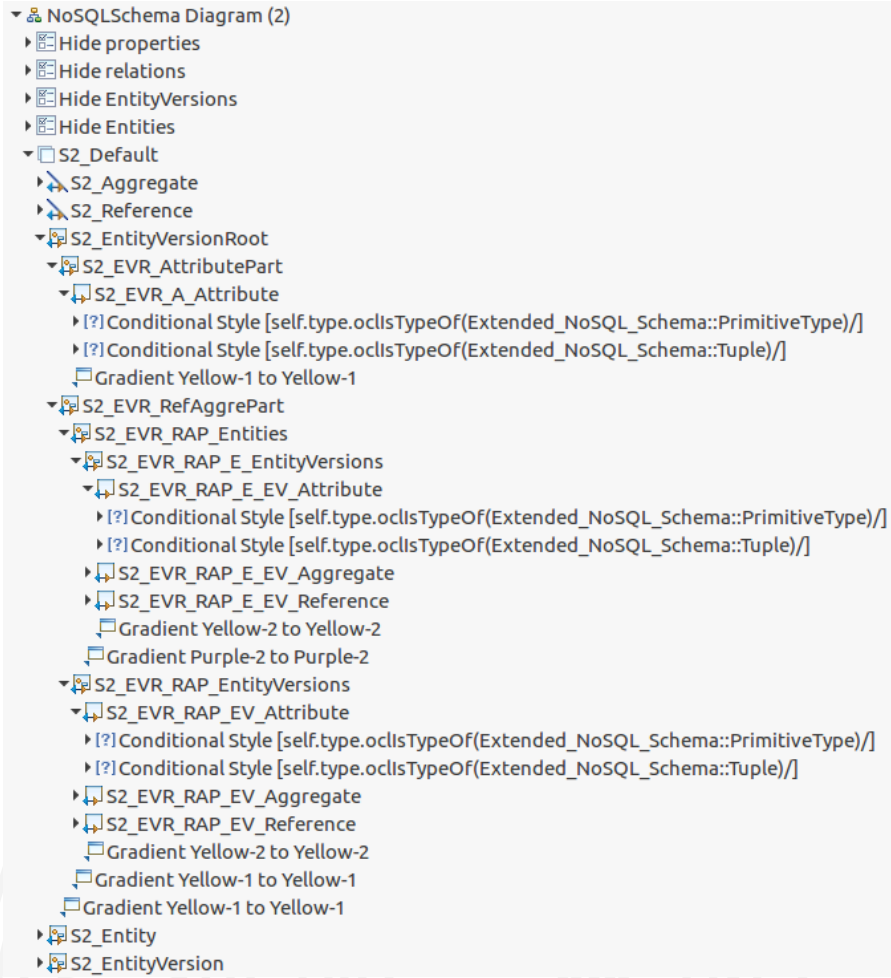
Schema visualization - Schema version (IV)

Implementation of the Schema view





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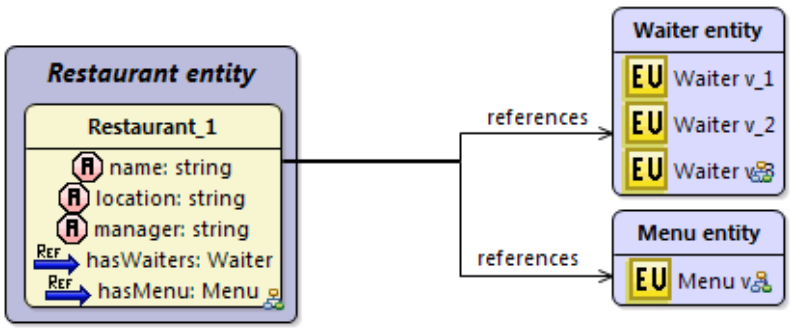
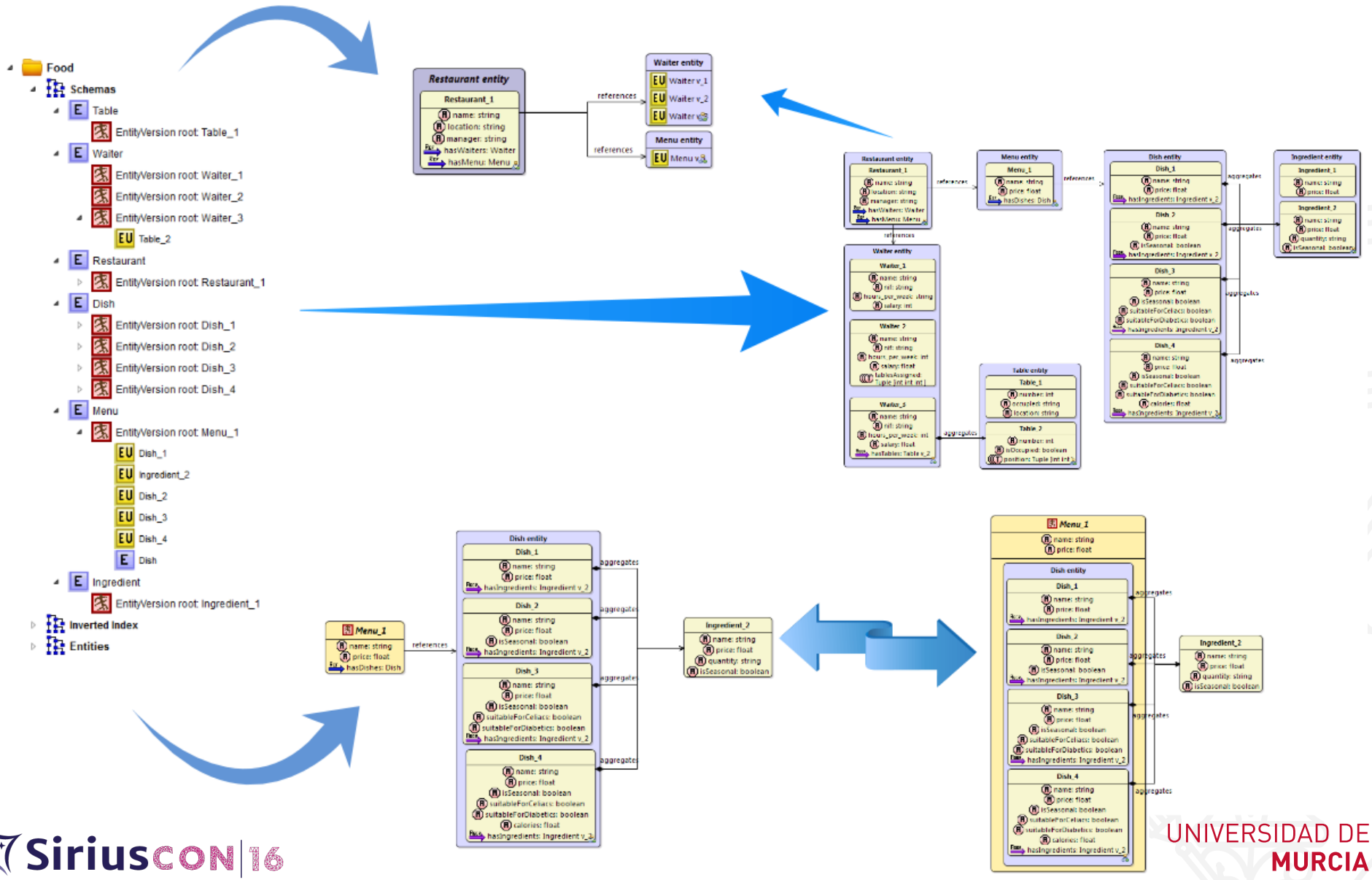
Schema visualization - Entity detail

Entity detail with its Versions associations



Navigation between views



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To sum up (I)

About Sirius...

- ✔ Built in the Eclipse Modeling Framework
- ✔ Easily deployable along with the metamodel into plugins
- ✔ Different viewpoints, layers and customization options
- ✔ Less development time and easier to extend
- ✘ AQL might be quite tricky sometimes when defining actions
- ✘ Learning curve for creating complex examples may be too harsh
- ? Language/model maintenance and evolution
- ? Managing large input models

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To sum up (II)

About the tool...

- We developed one of the first approaches for NoSQL visualization considering versions
- Tool to visualize NoSQL database schemas and schema versions with Sirius
  - Tree viewpoint and global schema viewpoint
  - Schema version and entity detail viewpoint
- ...but there is still a lot of work to do:
  - Polish the NoSQL_Schema metamodel
  - Improve the Sirius viewpoint definitions
  - Implement the editor functionality

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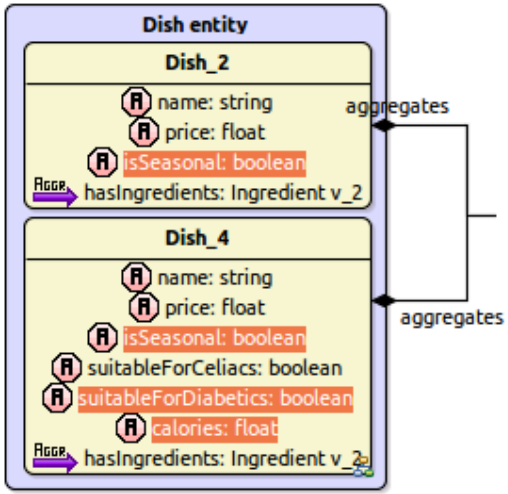
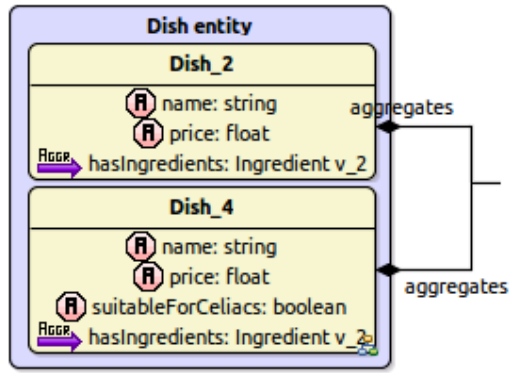
Future work (I) - DB alterations



Removing attributes




```
{
    "_id": 45,
    "type": "Dish",
    "name": "value_190",
    "price": 0.43,
    "isSeasonal": true,
    "hasIngredients": ...
},
{
    "_id": 50,
    "type": "Dish",
    "name": "value_77",
    "price": 53.84,
    "isSeasonal": false,
    "suitableForCeliacs": false,
    "suitableForDiabetics": true,
    "calories": 7.16,
    "hasIngredients": ...
},
```


```
hbase(main):001:0> delete 'food_db', '45', ...
                       ... 'isSeasonal'
hbase(main):002:0* delete 'food_db', '50', ...
                       ... 'isSeasonal', 'suitableForDiabetics', 'calories'
```

Generate transformation scripts for the DB


```
{
    "_id": 45,
    "type": "Dish",
    "name": "value_190",
    "price": 0.43,
    "hasIngredients": ...
},
{
    "_id": 50,
    "type": "Dish",
    "name": "value_77",
    "price": 53.84,
    "suitableForCeliacs": false,
    "hasIngredients": ...
},
```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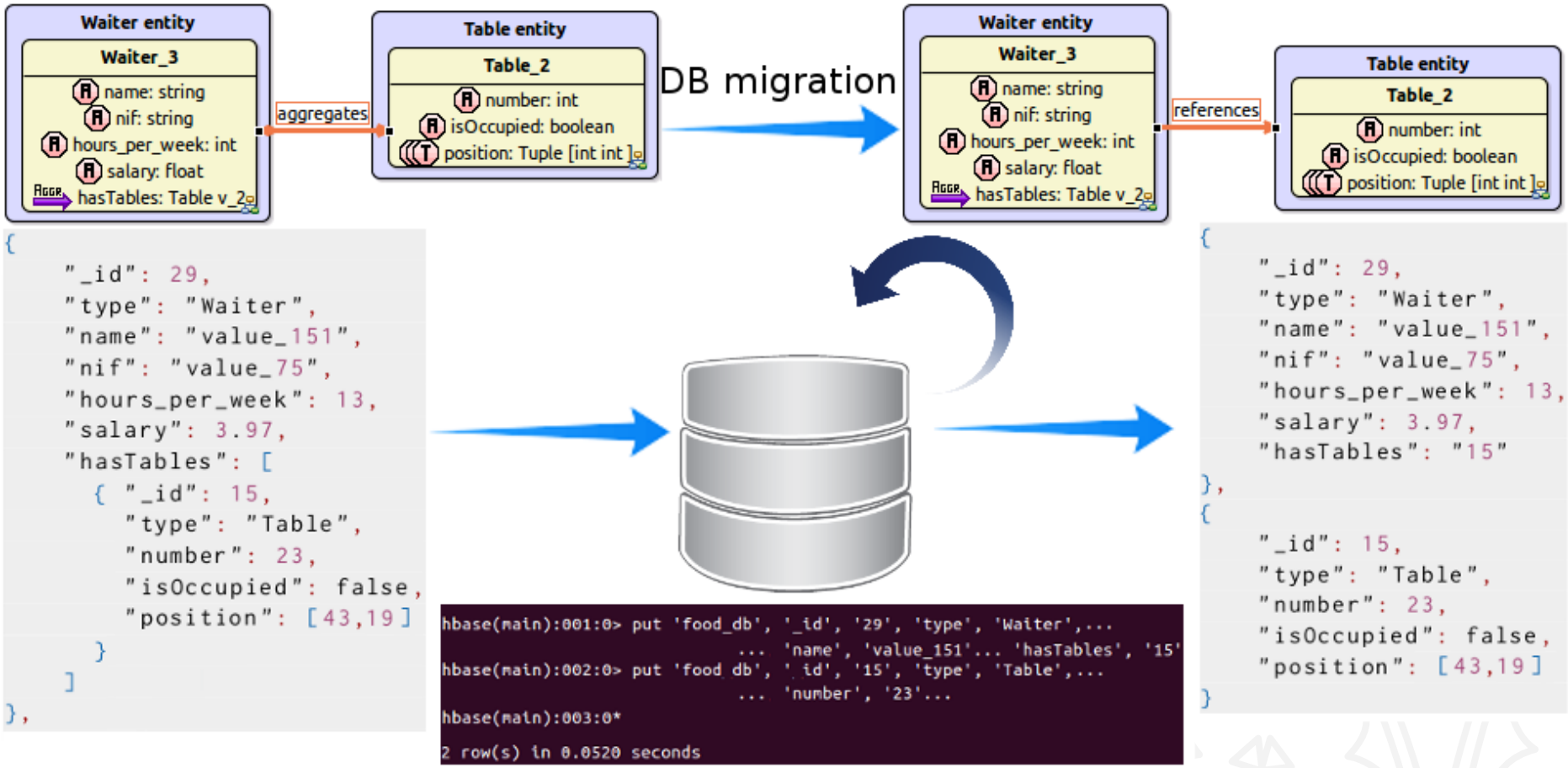
Future work (II) - DB migration



Generate migration scripts for the DB

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