COMP3005 Project Report

Yannick Abouem - Student# 101151033

December 9, 2022

Contents

1 Conceptual Design

1.1 Cardinalities and Participation Types Explanation

Following is a more detailed overview of each relationship with an explanation of its cardinality and participation from member entities, as well as a closer look to the member entities.

1.1.1 Has Relationship

The Has Relationship occurs between the User entity and the Checkout Basket weak entity and its the identifying relationship for Checkout Basket. This relationship has a 1:1 cardinality with total participation the Checkout Basket and partial participation for the User Entity. The cardinality is such because each User can only have one Checkout Basket and Checkout Baskets are not shared between users. The relationship requires total participation for the Checkout Basket entity since its the identifying relationship for the Checkout Basket and the User's checkout basket might be created when needed.

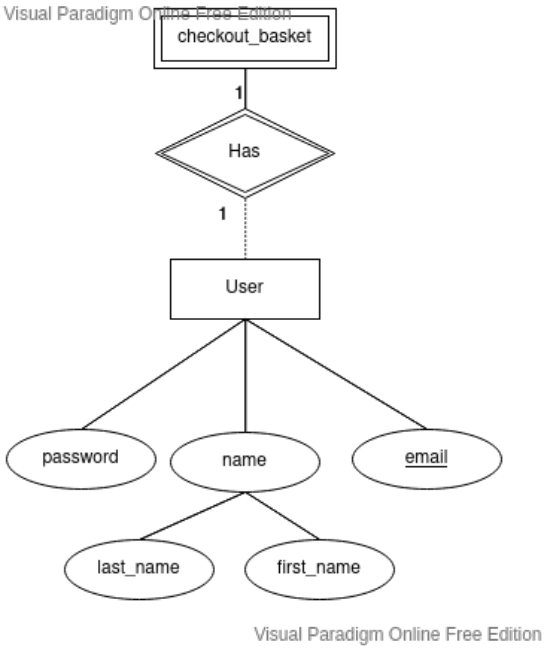


Figure 1.1: Has relationship ER-diagram

1.1.2 In Basket Relationship

The In Basket relationship occurs between the Book entity and the Checkout Basket weak entity. This relationship is a N:M relationship with partial participation for both entities. The N:M cardinality is used for this relationship as each book can be in multiple checkout baskets simultaneously and each checkout basket can have multiple different books. Both entities have a optional participation in this relationship as both entities can exists without being in this relationship. For example a book does not have to be in a basket if its not being purchased and a checkout basket can be empty and still exist.

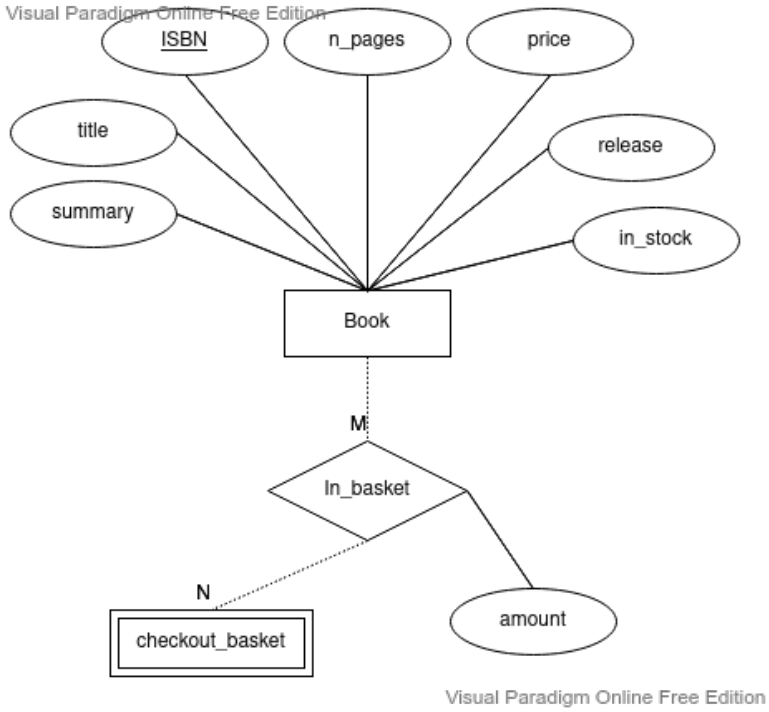


Figure 1.2: In Basket relationship ER-diagram

1.1.3 Is Genre

This relationship occurs between the Genre and Book relationship and its a N:M relationship with total participation for both entities. The cardinality of this relationship is N:M because each book can have multiple genre and each genre has a list of books which belongs to it. While the participation is total for both entities because books are classified by genre and therefore all books must have a genre. While genres which do not have at leas a book associated to it has no reason to be in the database.

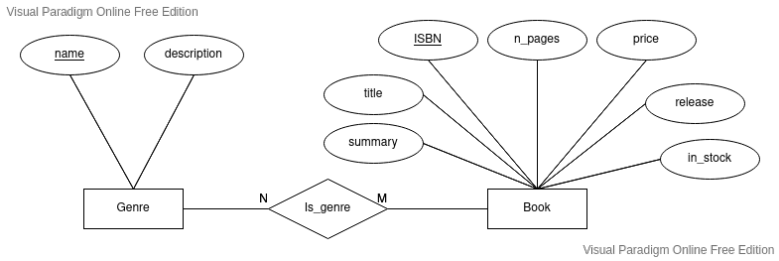


Figure 1.3: Is Genre relationship ER-diagram

1.1.4 Ordered

The Ordered relationship connects the Book entity and the Order entity with a N:M cardinality and total participation for the Order entity and partial participation for the Book entity. The N:M cardinality is due to the fact that each order can have multiple books and each book can be placed in multiple different orders. The Order entity's total participation is caused by the nature of the order itself (i.e. we cannot have empty orders) while the partial participation for the Book entity is caused by the fact that a book does not have to be ordered in order to exists in the database. This relationship also has an attribute called amount. This attribute serves to simplify the ordering of the same book multiple times.

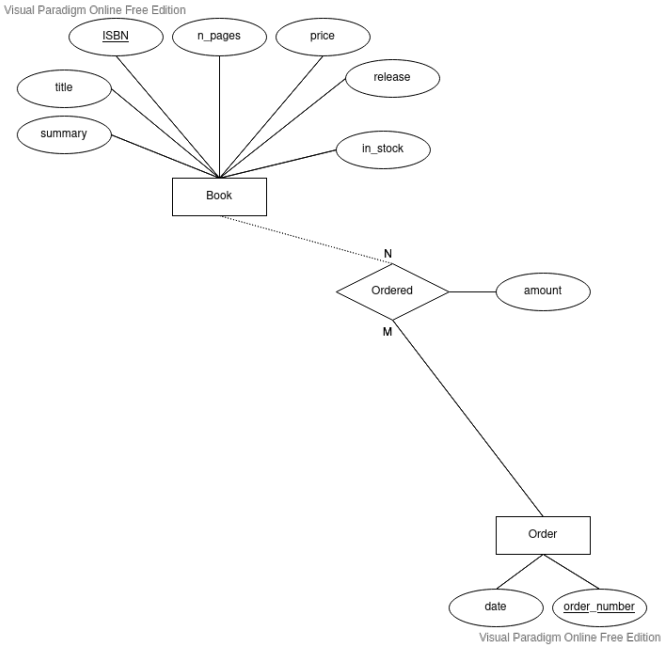


Figure 1.4: Ordered relationship ER-diagram

1.1.5 Payment

This relationship connects the Order entity and the Billing Info weak entity and is the defining relationship of the latter. It's a 1:1 relationship with total participation for the Billing Info entity and partial for the Order entity. This is a fairly straight forward relationship which serves to connect the order to its payment informations. Each order can only have one payment information and one payment information has one order since payment informations must not be shared between orders since there is the potential risk of leaking the user banking informations. Similarly the relationship requires total participation for the Billing Info since these informations are part of the order. While its a partial

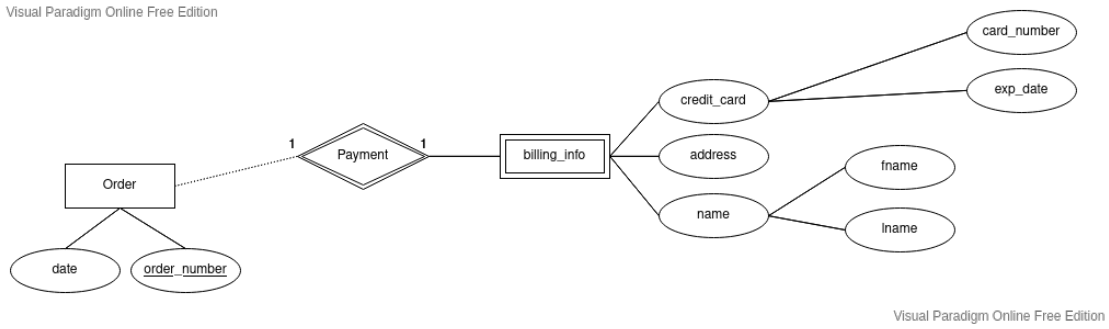


Figure 1.5: Payment relationship ER-diagram

1.1.6 Places

This 1:N relationship occurs between the User entity and the Order entity. It has a partial participation for the User and a total participation for the Order. Each user can create and own N orders while each order can have only one user, orders cannot be shared or owned by multiple users. Users do not have to place an order, hence the partial participation, while orders must have a user who owns said order.

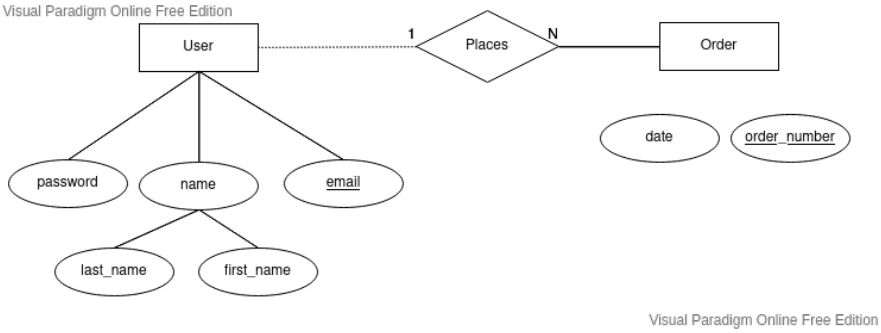


Figure 1.6: Places relationship ER-diagram

1.1.7 Publish

This 1:N relationship occurs between the Book entity and the Publisher entity. This relationship is due to the fact that each Book only has one publisher and each publisher can publish multiple books. Both entities have a total participation as books have to be published and publishers without published books are of no use in this application. This relationship has an attribute Publisher Percentage which serves to indicate how much the publisher will gain from the sale of the specified book.

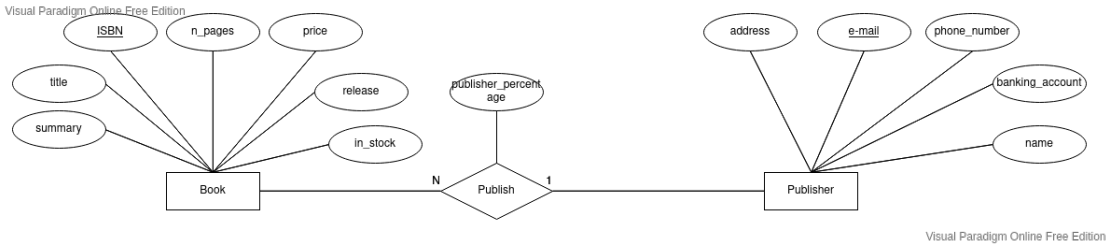


Figure 1.7: Publish relationship ER-diagram

1.1.8 Ship To

The Ship To relationship is a 1:1 relationship which requires total participation from the Shipping Info weak entity, since it's its defining relationship, and partial participation from the Order entity. This is due to the fact that each order only has one address that needs to be delivered to and shipping informations are not shared between orders. The partial participation with the Order entity is due to redundancy since its possible to use billing informations as shipping informations.

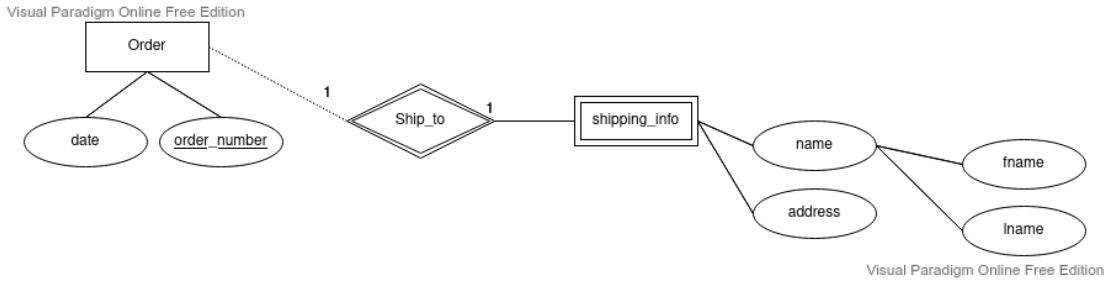


Figure 1.8: Ship To relationship ER-diagram

1.1.9 Tracks

This 1:1 relationship is the defining relationship of the Tracking Information entity and connects it to the Order entity. Total participation is required for the Tracking Information entity since each tracking information cannot exist on is own and partial for the Order entity since orders which are not shipped yet have not shipping information. Each order only has one tracking information.

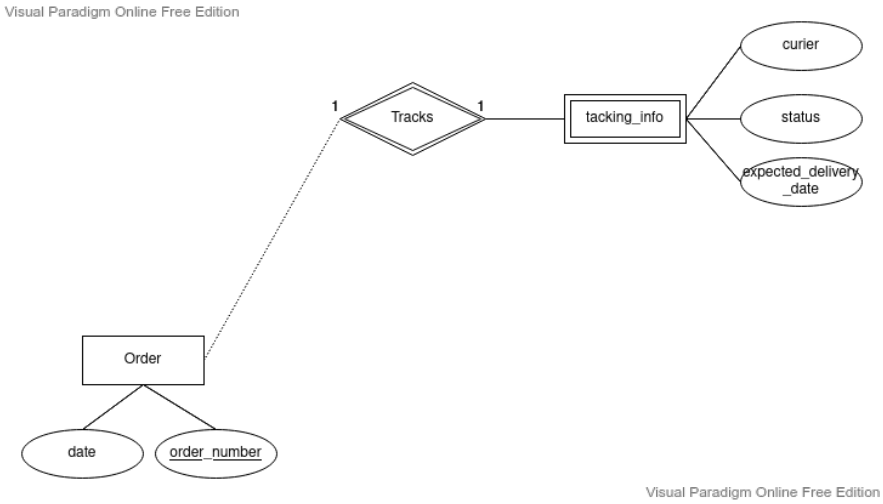


Figure 1.9: Tracks relationship ER-diagram

1.1.10 Wrote

The Wrote relationship occurs between the Author and Book entities. Its a N:M relationship with total participation required for both entities. This is due to the fact that each author can write multiple books and some books are co-authored by multiple authors. There are no books that don't have a author (books with unknown author can be created with an author named unknown) and authors without books are irrelevant for our application.

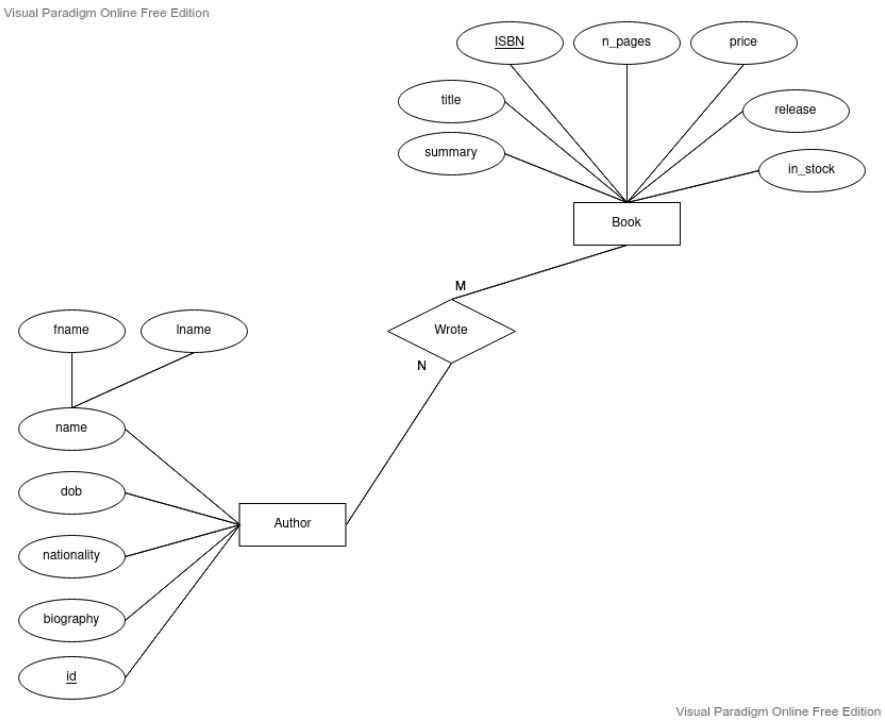
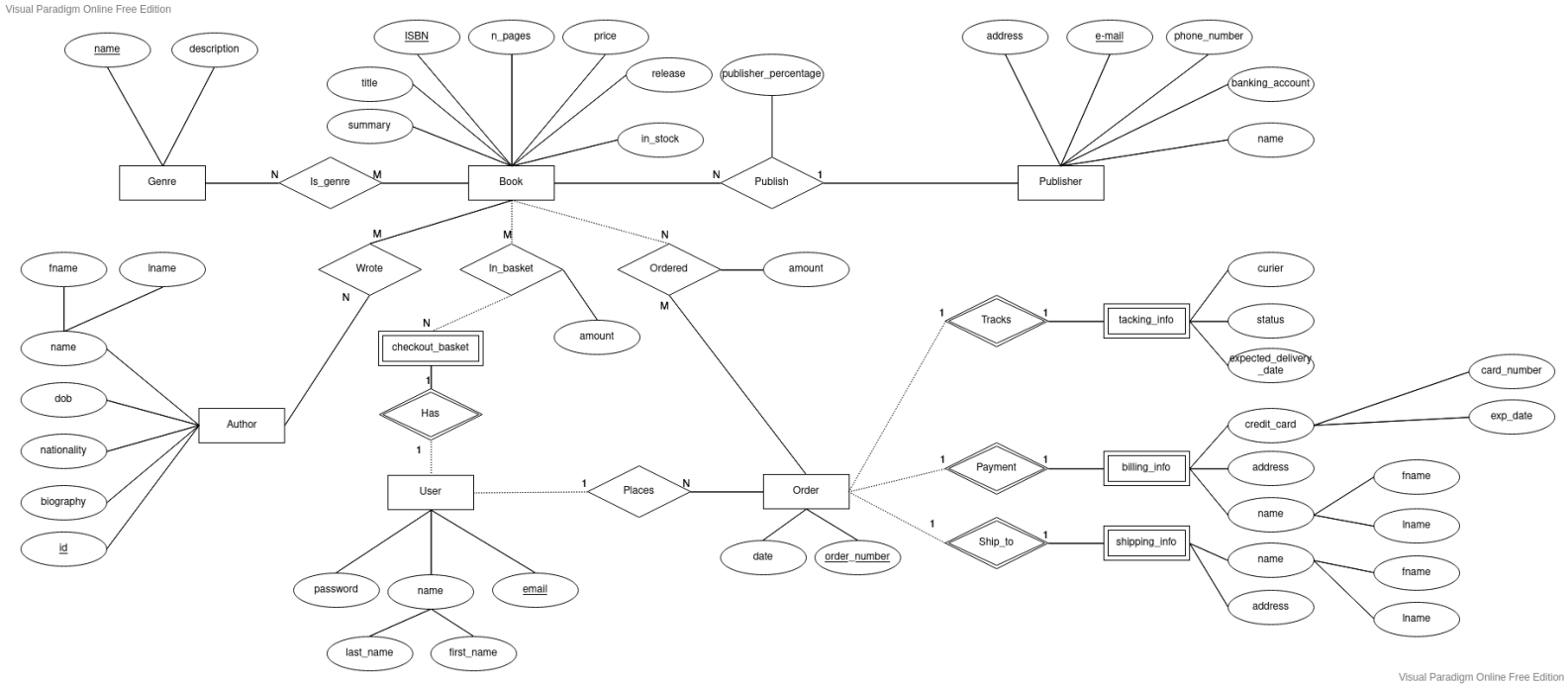


Figure 1.10: Wrote relationship ER-diagram

1.2 Full ER-Diagram

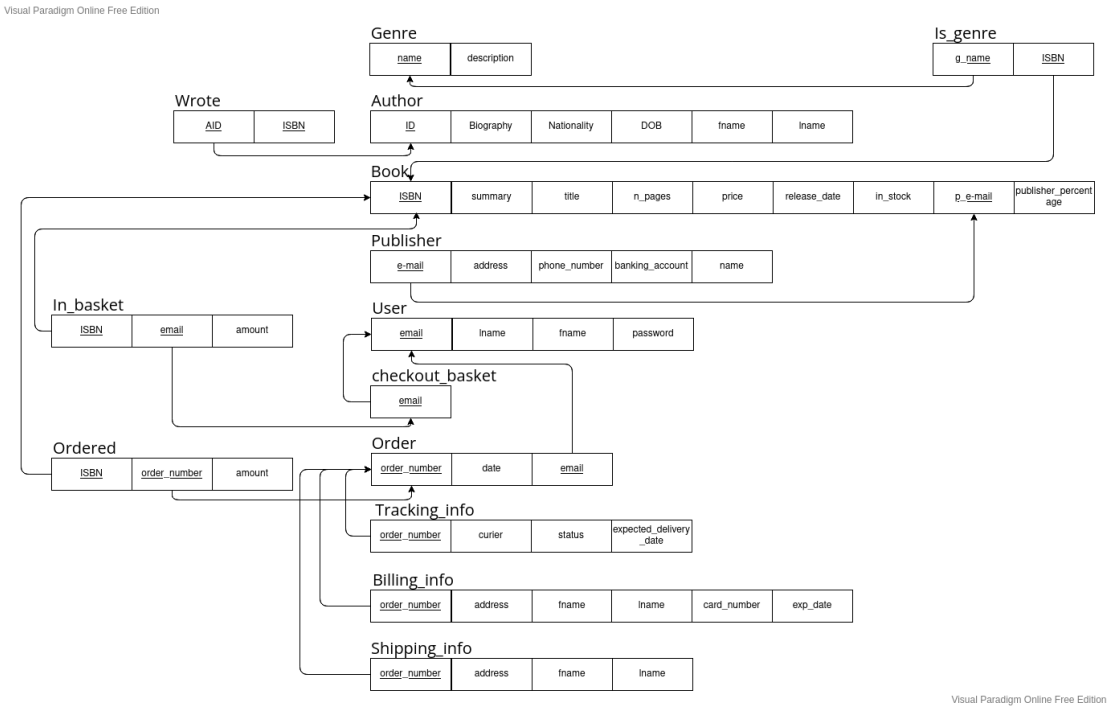
In the following page you can find the full ER-Diagram for the database.



2 Relation Schemas

2.1 Relation Schemas Reduced From ER-Diagram

Following is the list of relation schemas reduced from the ER-Diagram.



2.2 Normalization of Relation Schemas

2.2.1 Normal Form Test

Genre

$$R = genre(name, description)$$

$$F = \{name \rightarrow description\}$$

Calculate $(name)^+$

$$result = name$$
$$name \rightarrow description : result = name, description$$
$$(name)^+ = name, description$$
$$(name)^+ = R$$

Genre is in BCNF.

Author

$$R = author(ID, bio, nationality, DOB, fname, lname)$$

$$\begin{aligned} F = \{&ID \rightarrow bio \\ &ID \rightarrow nationality \\ &ID \rightarrow DOB \\ &ID \rightarrow fname, lname\} \end{aligned}$$

Calculate if ID is a superkey of R

$$(ID)^+$$
$$result = ID$$
$$ID \rightarrow bio : result = ID, bio$$
$$ID \rightarrow nationality : result = ID, bio, nationality$$
$$ID \rightarrow DOB : result = ID, bio, nationality, DOB$$
$$ID \rightarrow fname, lname : result = ID, bio, nationality, DOB, fname, lname$$
$$(ID)^+ = ID, bio, nationality, DOB, fname, lname$$

Therefore ID is superkey of $author$ and the relational schema is in BCNF.

Book

$$R = book(prefix, group, ISBN, summary, title, n\_pages, price, release\_date, in\_stock, p\_email, publisher\_percentage)$$

$$\begin{aligned} F = \{ & ISBN \rightarrow summary \\ & ISBN \rightarrow title \\ & ISBN \rightarrow n\_pages \\ & ISBN \rightarrow price \\ & ISBN \rightarrow release\_date \\ & ISBN \rightarrow in\_stock \\ & publisher \rightarrow p\_email \\ & ISBN \rightarrow publisher\_precentage\} \end{aligned}$$

Calculate if $ISBN$ is superkey of R

$(ISBN)^+$
$result = ISBN$
$ISBN \rightarrow summary : result = ISBN, summary$
$ISBN \rightarrow title : result = ISBN, summary, title$
$ISBN \rightarrow n\_pages : result = ISBN, summary, title, n\_pages$
$ISBN \rightarrow price : result = ISBN, summary, title, n\_pages, price$
$ISBN \rightarrow release\_date : result = ISBN, summary, title, n\_pages$
$price, release\_date$
$ISBN \rightarrow in\_stock : result = ISBN, summary, title, n\_pages$
$prices, release\_date, in\_stock$
$ISBN \rightarrow p\_email : result = ISBN, summary, title, n\_pages$
$prices, release\_date, in\_stock, p\_email$
$ISBN \rightarrow publisher\_precentage \ : result = ISBN, summary, title$
$n\_pages, prices, release\_date, in\_stock, p\_email, publisher\_percentage$
$(ISBN)^+ = ISBN, summary, title, n\_pages, prices, release\_date,$
$in\_stock, p\_email, publisher\_percentage$

Therefore $ISBN$ is superkey of $Book$ and the relational schema is in BCNF.

Publisher

$$R = publisher(email, address, phone\_number, banking\_account, name)$$

$$\begin{aligned} F = \{&email \rightarrow address \\ &email \rightarrow phone\_number \\ &email \rightarrow banking\_account \\ &email \rightarrow name\} \end{aligned}$$

Find if $email$ is superkey of R:

$(email)^+$
$result = email$
$email \rightarrow address : result = email, address$
$email \rightarrow phone\_number : result = email, address, phone\_number$
$email \rightarrow banking\_account : result = email, address$
$phone\_number, banking\_account$
$email \rightarrow name : result = email, address, phone\_number$
$banking\_account, name$
$(email)^+ = email, address, phone\_number, banking\_account, name$

Since $email$ is superkey of R no relation causes a violation of BCNF, therefore Publisher is in normal form.

User

$$R = useremail, lname, fname, password$$

$$\begin{aligned} F = \{&emali \rightarrow lname \\ &email \rightarrow fname \\ &email \rightarrow password\} \end{aligned}$$

Normal form test of R by finding if $email$ is superkey.

$(email)^+$
$result = email$
$emali \rightarrow lname : result = email, lname$
$emali \rightarrow fname : result = email, lname, fname$
$emali \rightarrow password : result = email, lname, fname, password$
$(email)^+ = email, lanme, fname, password$
$(email)^+ = R$

$email$ is superkey of R, therefore no functional dependency in F is in violation of BCNF and user is in normal form.

Checkout Basket

$$R = checkout_basket(email)$$

$$F = \{email \rightarrow email\}$$

The functional dependency $email \rightarrow email$ is trivial and the only functional relation. Therefore checkout basket is in normal form.

Order

$$R = order(order\_number, date, email)$$

$$F = \{order\_number \rightarrow date, email\}$$

Normal form test for R by finding if $order\_number$ is superkey.

$$(order\_numner)^+$$
$$result = order\_number$$
$$order\_number \rightarrow date, email : result = order\_number, date, email$$
$$(order\_number)^+ = order\_number, date, email$$
$$(order\_number)^+ = R$$

Since $order\_number$ superkey of R and no functional dependency is in violation of BCNF, then order is in normal form.

Tracking Info

$$R = tracking\_info(order\_number, curier, status, expected\_delivery\_date)$$

$$F = \{oredr\_number \rightarrow curier$$
$$order\_number \rightarrow status$$
$$order\_number \rightarrow expected\_delivery\_date\}$$

Normal form test for R by finding if $order\_number$ is superkey.

$$(order\_number)^+$$
$$result = order\_number$$
$$oredr\_number \rightarrow curier : result = order\_number, curier$$
$$oredr\_number \rightarrow status : result = order\_number, curier, status$$
$$oredr\_number \rightarrow expected\_delivery\_date : result = order\_number$$
$$curier, status, expected\_delivery\_date$$
$$(order\_number)^+ = order\_number, curier, status, expected\_delivery\_date$$
$$(order\_number)^+ = R$$

Since $order\_number$ superkey of R and no functional dependency is in violation of BCNF, then tracking info is in normal form.

Billing Info

$$R = billing\_info(order\_number, address, fname, lname, card\_number, exp\_date)$$

$$F = \{order\_number \rightarrow address$$
$$order\_number \rightarrow fname, lname$$
$$order\_number \rightarrow card\_number$$
$$order\_number \rightarrow exp\_date\}$$

Normal form test for R by finding if $order\_number$ is superkey.

$(order\_number)^+$
$result = order\_number$
$order\_number \rightarrow address : result = order\_number, address$
$order\_number \rightarrow fname, lname : result = order\_number, address,$
$fname, lname$
$order\_number \rightarrow card\_number : result = order\_number, address,$
$fname, lname, card\_number$
$order\_number \rightarrow exp\_date : result = order\_number, address,$
$fname, lname, card\_number, exp\_date$
$(order\_number)^+ = order\_number, address, fname, lname, card\_number,$
exp_date
$(order\_number)^+ = R$

Since $order\_number$ superkey of R and no functional dependency is in violation of BCNF, then billing info is in normal form.

Shipping Info

$$R = shipping\_info(order\_number, address, fname, lname)$$

$$F = \{order\_number \rightarrow address$$
$$order\_number \rightarrow fname, lname\}$$

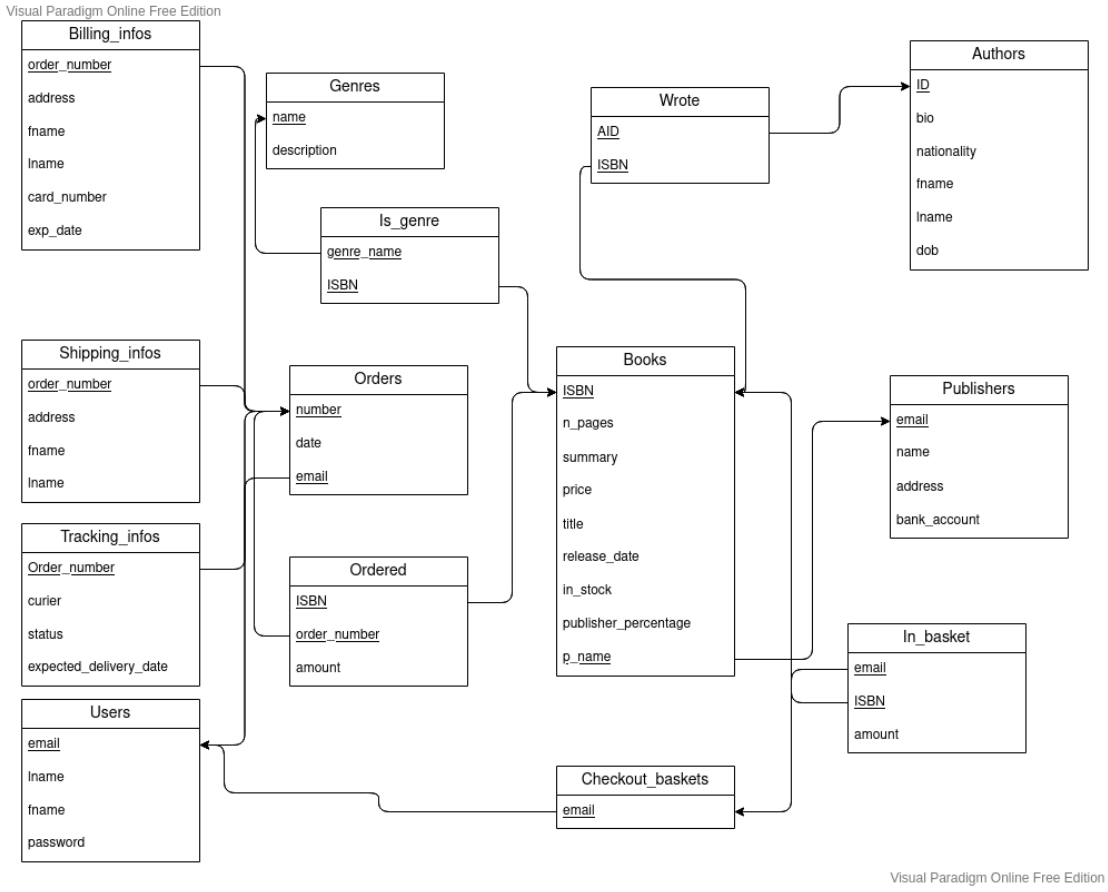
Normal form test for R by finding if $order\_number$ is superkey.

$(order\_number)^+$
$result = order\_number$
$order\_number \rightarrow address : result = order\_number, address$
$order\_number \rightarrow fname, lname : result = order\_number, address,$
$fname, lname$
$(order\_number)^+ = order\_number, address, fname, lname$
$(order\_number)^+ = R$

Since *order_number* superkey of R and no functional dependency is in violation of BCNF, then shipping info is in normal form.

3 Database Schema Diagram

Here you can find the final schema diagram of the database.



4 Implementation

Here is the link to the project repository:
`https://github.com/AntaresMKII/COMP3005-project`

5 Appendix

Availability:

- 10am - 10:20am
- 10am - 10:40am
- 1pm - 1:20pm