

**Lab 3: Relational Schema**

SC2207 - Introduction to Databases

**SCSY Team 5**

| **Name** | **Matriculation Number** |
| --- | --- |
| Gauthaman Ramya Varshini | U2123023K |
| Pearlina Tan Qinlin | U2221690F |
| Chin Ao-Wen | U2240595B |
| Tan Jie Ning, Jolynn | U2220577B |
| Sum Yuan Sen | U2221346D |
| Vilan Chan | U2020092L |

**Database Schema**

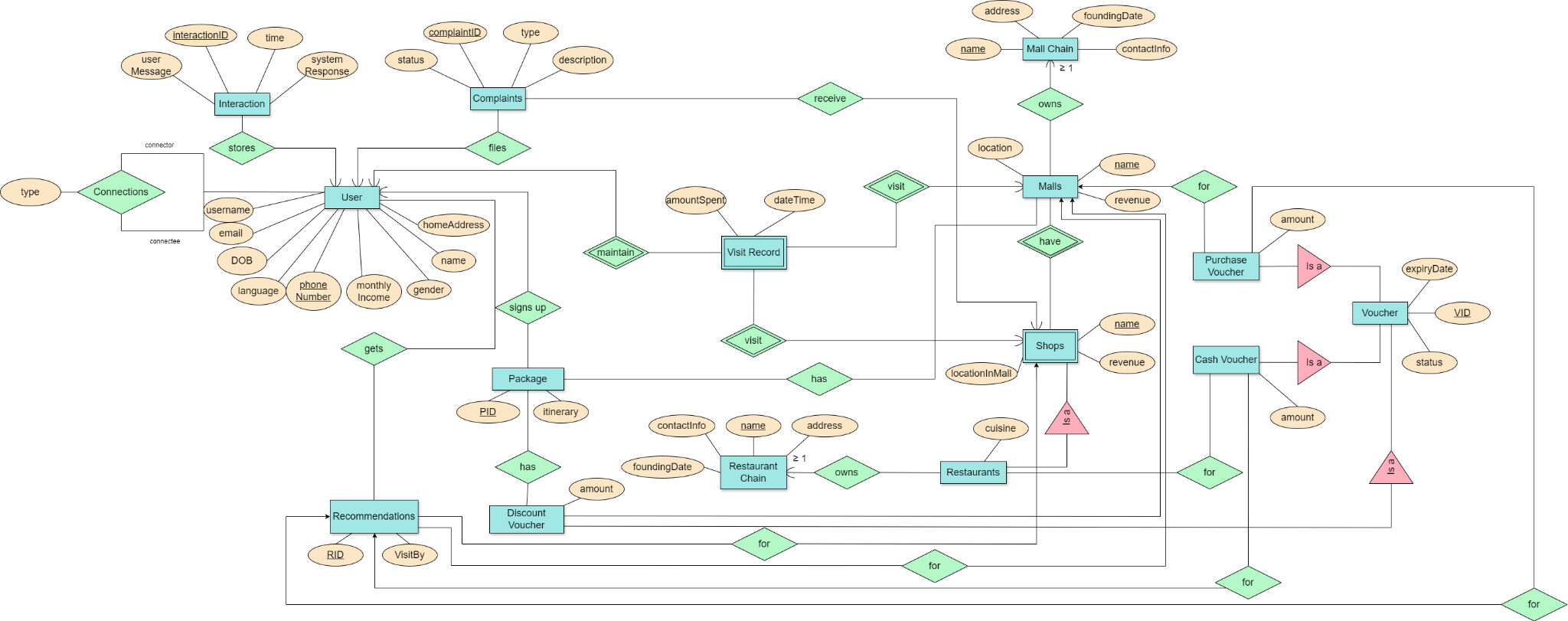


Figure 1: Reference ER Diagram

**Relation 1**

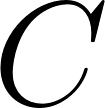
**User**(phoneNumber, DOB, language, name, gender, email, monthlyIncome, homeAddress, username)

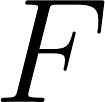
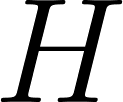
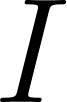
**Keys**: phoneNumber

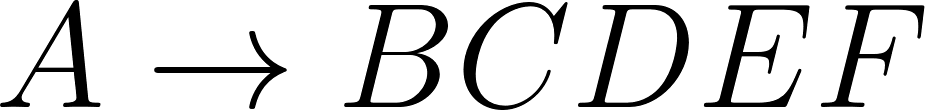
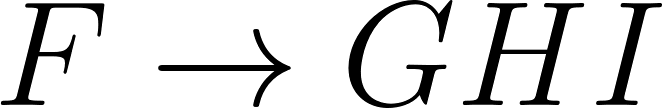
**Functional Dependencies:**

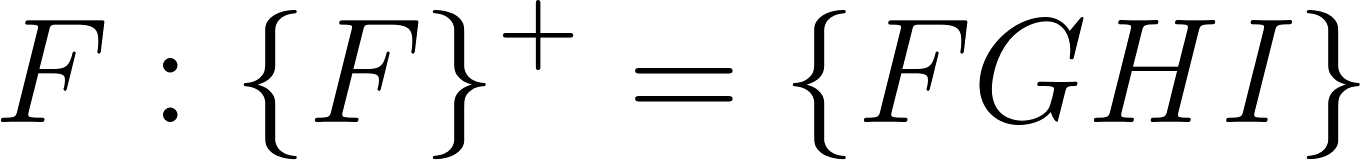
1. phoneNumber [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) DOB, language, name, gender, email
2. email [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) monthlyIncome, homeAddress, username

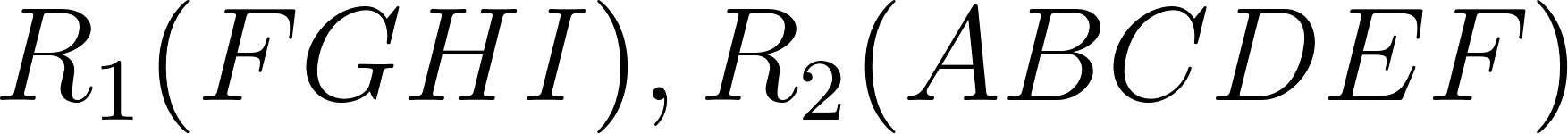
**Assumptions**: When the user wants to submit his/her email address, they must enter all the other optional information as well (monthlyIncome, homeAddress, username).

**Decomposition**: Let attributes of User be [](https://www.codecogs.com/eqnedit.php?latex=A#0): phoneNumber, [](https://www.codecogs.com/eqnedit.php?latex=B#0):DOB, [](https://www.codecogs.com/eqnedit.php?latex=C#0):language,

[](https://www.codecogs.com/eqnedit.php?latex=D#0):name, [](https://www.codecogs.com/eqnedit.php?latex=E#0):gender, [](https://www.codecogs.com/eqnedit.php?latex=F#0): email, [](https://www.codecogs.com/eqnedit.php?latex=G#0):monthlyIncome, [](https://www.codecogs.com/eqnedit.php?latex=H#0):homeAddress, [](https://www.codecogs.com/eqnedit.php?latex=I#0):username). Then, the FDs become:

1. [](https://www.codecogs.com/eqnedit.php?latex=A%20%5Crightarrow%20%20BCDEF#0)
2. [](https://www.codecogs.com/eqnedit.php?latex=F%20%5Crightarrow%20GHI#0)

Closure of [](https://www.codecogs.com/eqnedit.php?latex=F%3A%20%5C%7BF%5C%7D%5E%2B%20%3D%20%5C%7BFGHI%5C%7D#0)

Decomposed into [](https://www.codecogs.com/eqnedit.php?latex=R_1(FGHI)%20%2C%20R_2(ABCDEF)#0)

The relation is now in BCNF.

**Relation 2**

**Interaction** (interactionID, time, systemResponse, userMessage, user\_phoneNumber)

**Key**: interactionID

**FDs**: interactionID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) time, systemResponse, userMessage, user\_phoneNumber

The relation is in BCNF.

**Relation 3**

**Connections** (connector\_phoneNumber, connectee\_phoneNumber , type)

**Keys**: connector\_phoneNumber, connectee\_phoneNumber

**Primary Key**: connector\_phoneNumber

**Functional Dependencies**:

1. connector\_phoneNumber, connectee\_phoneNumber [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) type
2. connector\_phoneNumber [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) connectee\_phoneNumber
3. connectee\_phoneNumber [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) connector\_phoneNumber

The relation is in BCNF.

**Relation 4**

**Complaints** (complaintID, type, description, status, user\_phoneNumber, shop\_name)

**Keys**: complaintID

**Primary key:** complaintID

**FDs**: complaintID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) type, description, status, user\_phoneNumber, shop\_name

The relation is in BCNF.

**Relation 5**

**Voucher** (VID, status, expiryDate)

**Keys**: VID

**Primary key**: VID

**FDs**: VID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) status, expiryDate

The relation is in BCNF.

**Relation 6**

**Discount Voucher** (voucher\_VID, amount, mall\_name)

**Keys**: voucher\_VID

**Primary key**: voucher\_VID

**FDs**: voucher\_VID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) amount, mall\_name

The relation is in BCNF.

**Relation 7**

**Purchase Voucher** (voucher\_VID, amount, mall\_name, recommendations\_RID)

**Keys**: voucher\_VID

**Primary key**: voucher\_VID

**FDs**: voucher\_VID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) amount, mall\_name, recommendations\_ID

The relation is in BCNF.

**Relation 8**

**Cash Voucher** (voucher\_ID, amount, restaurant\_name, recommendations\_RID)

**Keys**: voucher\_ID

**FDs**: voucher\_ID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) amount, restaurant\_name, recommendations\_ID

The relation is in BCNF.

**Relation 9**

**Recommendations** (RID, visitBy, shop\_name, mall\_name, voucher\_VID )

**Keys**: RID

**FDs**: RID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) visitBy, shop\_name, mall\_name, voucher\_VID

The relation is in BCNF.

**Relation 10**

**user\_Recommendations** (user\_phoneNumber, recommendations\_RID)

**Keys**: user\_phoneNumber, reommendations\_RID

**Primary Key**: user\_phoneNumber

**FDs**: user\_phoneNumber, recommendations\_RID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) user\_phoneNumber, recommendations\_RID

The relation is in BCNF.

**Relation 11**

**Package** (PID, description, user\_phoneNumber)

**Keys**: PID

**FDs**: PID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) description, user\_phoneNumber

The relation is in BCNF.

**Relation 12**

**has\_PackageMall** (package\_PID, mall\_Name)

**Keys**: package\_PID, mall\_Name

**Primary Key**: package\_PID

**FDs**: package\_PID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) mall\_Name

The relation is in BCNF.

**Relation 13**

**has\_PackageDiscount** (package\_PID, discount\_voucher\_VID)

**Keys**: package\_PID, discount\_voucher\_VID

**Primary Key**: package\_PID

**FDs**: package\_PID [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) discount\_voucher\_VID

The relation is in BCNF.

**Relation 14**

**Mall Chain**(name, foundingDate, contactInfo, address)

**Keys**: name

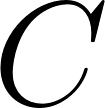
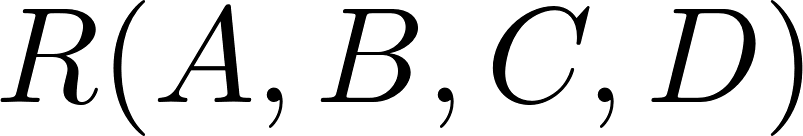
**Primary key**: name

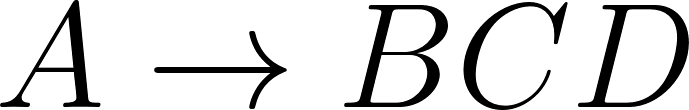
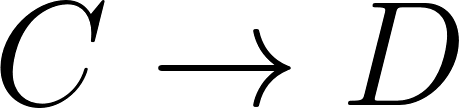
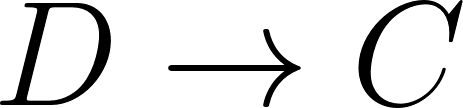
**Functional Dependencies**:

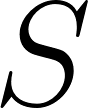
1. name [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) foundingDate, contactInfo, address
2. contactInfo [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) address
3. address [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) contactInfo

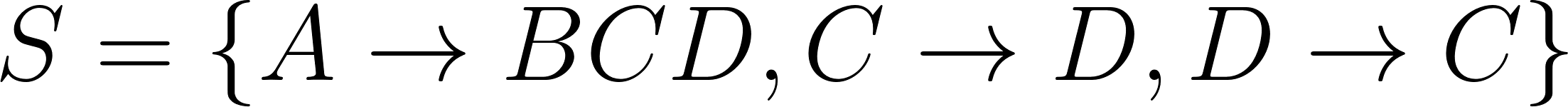
The relation is not in 3NF.

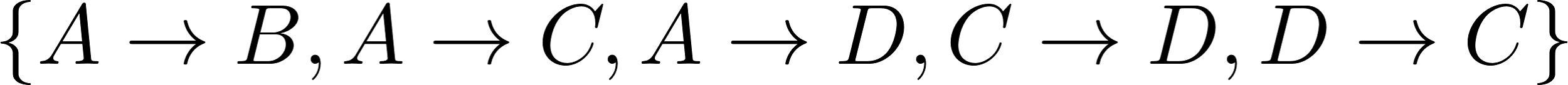
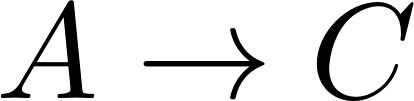
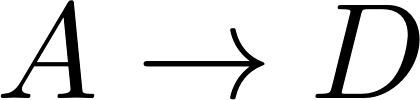
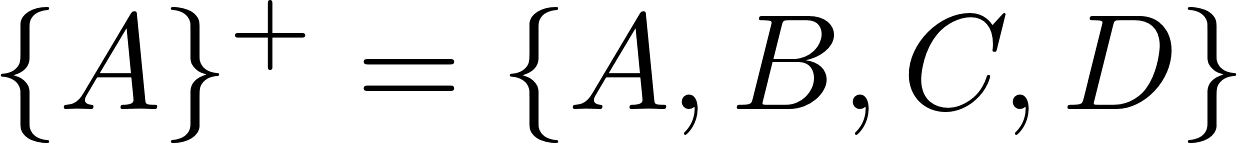
**Decomposition**

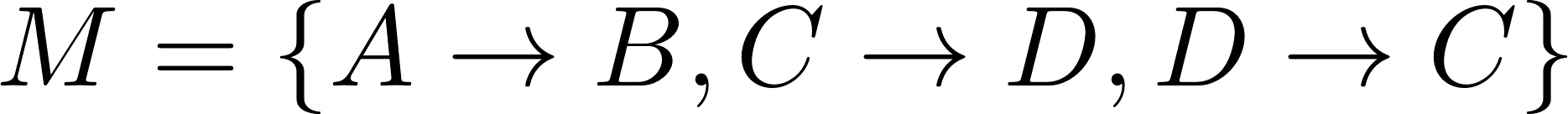
Let attributes of **Mall Chain** be ([](https://www.codecogs.com/eqnedit.php?latex=A#0): name, [](https://www.codecogs.com/eqnedit.php?latex=B#0): foundingDate, [](https://www.codecogs.com/eqnedit.php?latex=C#0): contactInfo, [](https://www.codecogs.com/eqnedit.php?latex=D#0): address). Then the FDs in Relation [](https://www.codecogs.com/eqnedit.php?latex=R(A%2CB%2CC%2CD)#0) become:

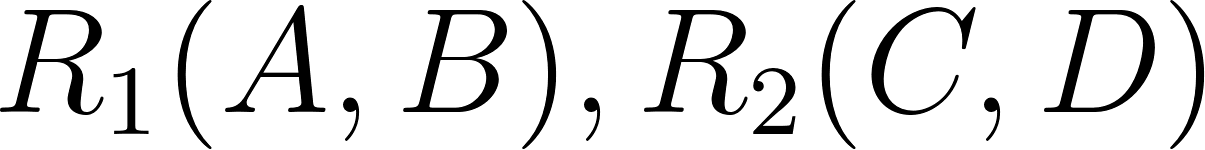
1. [](https://www.codecogs.com/eqnedit.php?latex=A%20%5Crightarrow%20BCD#0)
2. [](https://www.codecogs.com/eqnedit.php?latex=C%20%5Crightarrow%20D#0)
3. [](https://www.codecogs.com/eqnedit.php?latex=D%20%5Crightarrow%20C#0)

The set [](https://www.codecogs.com/eqnedit.php?latex=S#0) of all the FDs in Relation [](https://www.codecogs.com/eqnedit.php?latex=R#0) is:

[](https://www.codecogs.com/eqnedit.php?latex=S%20%3D%20%5C%7BA%20%5Crightarrow%20BCD%2C%20C%20%5Crightarrow%20D%2C%20D%20%5Crightarrow%20C%5C%7D#0)

1. Splitting the RHS, we get [](https://www.codecogs.com/eqnedit.php?latex=%5C%7BA%20%5Crightarrow%20B%2C%20A%20%5Crightarrow%20C%2C%20A%20%5Crightarrow%20D%2C%20C%5Crightarrow%20D%2C%20D%20%5Crightarrow%20C%5C%7D#0)
2. [](https://www.codecogs.com/eqnedit.php?latex=A%20%5Crightarrow%20C#0) and [](https://www.codecogs.com/eqnedit.php?latex=A%20%5Crightarrow%20D#0) are redundant because [](https://www.codecogs.com/eqnedit.php?latex=%5C%7BA%5C%7D%5E%2B%20%3D%20%5C%7BA%2CB%2CC%2CD%5C%7D#0)
3. There are no FDs with more than 1 attribute on the LHS

The final minimal basis is [](https://www.codecogs.com/eqnedit.php?latex=M%20%3D%20%5C%7BA%20%5Crightarrow%20B%2C%20C%5Crightarrow%20D%2C%20D%5Crightarrow%20C%20%5C%7D#0)

3NF decomposition is [](https://www.codecogs.com/eqnedit.php?latex=R_1(A%2CB)%2C%20R_2(C%2CD)#0)

**Final Decomposition**: [](https://www.codecogs.com/eqnedit.php?latex=R_1#0)(name, foundingDate) and [](https://www.codecogs.com/eqnedit.php?latex=R_2#0)(contactInfo, address).

The relation is now in 3NF.

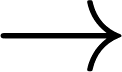
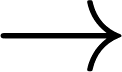
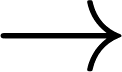
**Relation 15**

**Restaurant Chain**(name, contactInfo, foundingDate, address)

**Keys**: name

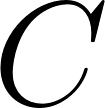
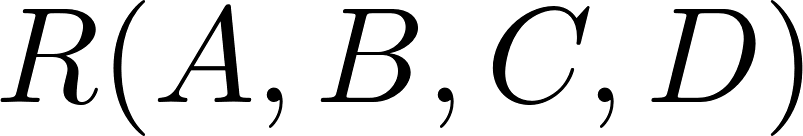
**Primary key**: name

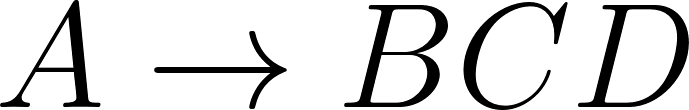
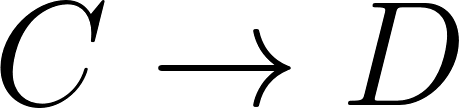
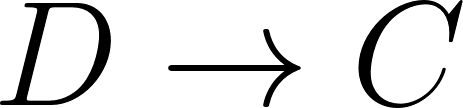
**Functional Dependencies**:

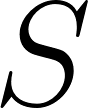
1. name [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) foundingDate, contact info, address
2. contact info [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) address
3. address [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) contact info

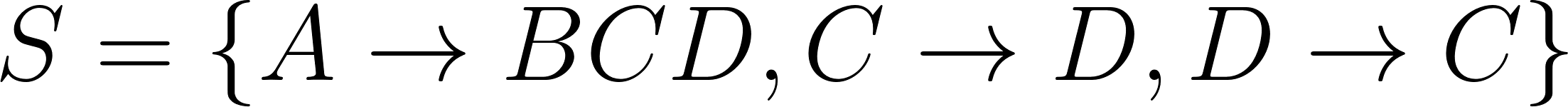
The relation is not in 3NF.

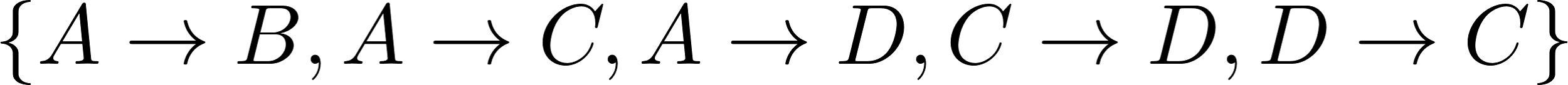
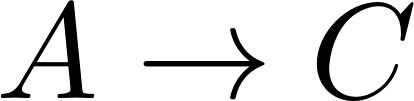
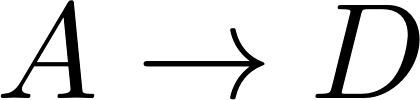
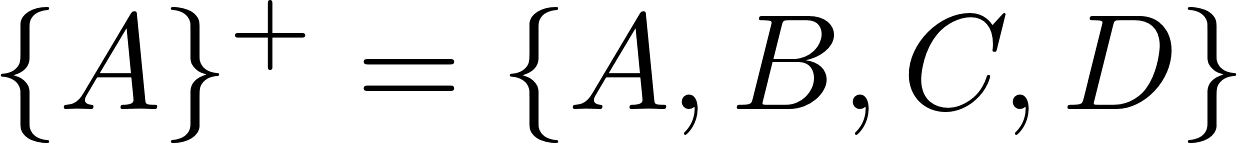
**Decomposition:**

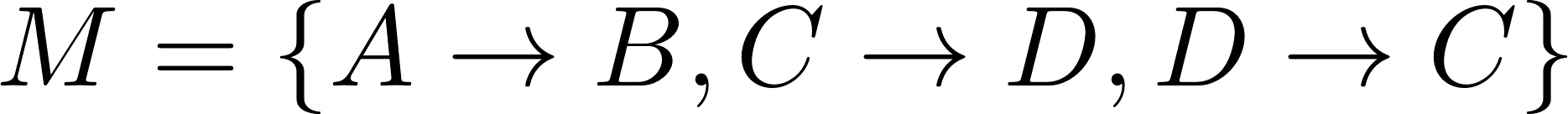
Let attributes of **Restaurant Chain** be ([](https://www.codecogs.com/eqnedit.php?latex=A#0): name, [](https://www.codecogs.com/eqnedit.php?latex=B#0): foundingDate, [](https://www.codecogs.com/eqnedit.php?latex=C#0): contactInfo, [](https://www.codecogs.com/eqnedit.php?latex=D#0): address). Then the FDs in Relation [](https://www.codecogs.com/eqnedit.php?latex=R(A%2CB%2CC%2CD)#0) become:

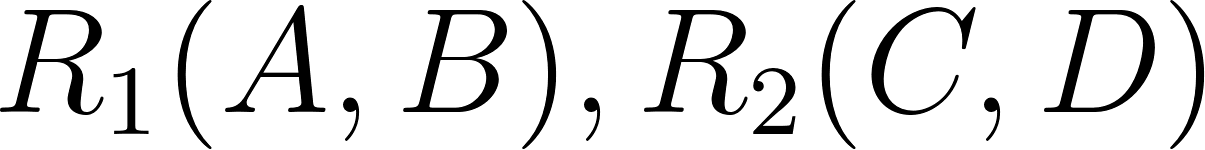
1. [](https://www.codecogs.com/eqnedit.php?latex=A%20%5Crightarrow%20BCD#0)
2. [](https://www.codecogs.com/eqnedit.php?latex=C%20%5Crightarrow%20D#0)
3. [](https://www.codecogs.com/eqnedit.php?latex=D%20%5Crightarrow%20C#0)

The set [](https://www.codecogs.com/eqnedit.php?latex=S#0) of all the FDs in Relation [](https://www.codecogs.com/eqnedit.php?latex=R#0) is:

[](https://www.codecogs.com/eqnedit.php?latex=S%20%3D%20%5C%7BA%20%5Crightarrow%20BCD%2C%20C%20%5Crightarrow%20D%2C%20D%20%5Crightarrow%20C%5C%7D#0)

1. Splitting the RHS, we get [](https://www.codecogs.com/eqnedit.php?latex=%5C%7BA%20%5Crightarrow%20B%2C%20A%20%5Crightarrow%20C%2C%20A%20%5Crightarrow%20D%2C%20C%5Crightarrow%20D%2C%20D%20%5Crightarrow%20C%5C%7D#0)
2. [](https://www.codecogs.com/eqnedit.php?latex=A%20%5Crightarrow%20C#0) and [](https://www.codecogs.com/eqnedit.php?latex=A%20%5Crightarrow%20D#0) are redundant because [](https://www.codecogs.com/eqnedit.php?latex=%5C%7BA%5C%7D%5E%2B%20%3D%20%5C%7BA%2CB%2CC%2CD%5C%7D#0)
3. There are no FDs with more than 1 attribute on the LHS

The final minimal basis is [](https://www.codecogs.com/eqnedit.php?latex=M%20%3D%20%5C%7BA%20%5Crightarrow%20B%2C%20C%5Crightarrow%20D%2C%20D%5Crightarrow%20C%20%5C%7D#0)

3NF decomposition is [](https://www.codecogs.com/eqnedit.php?latex=R_1(A%2CB)%2C%20R_2(C%2CD)#0).

**Final Decomposition**: [](https://www.codecogs.com/eqnedit.php?latex=R_1#0)(name, foundingDate) and [](https://www.codecogs.com/eqnedit.php?latex=R_2#0)(contactInfo, address).

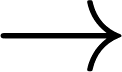
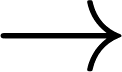
The relation is now in 3NF.

**Relation 16**

**Shops** (name, revenue, locationInMall, mall\_name)

**Keys**: (mall\_name, name) Composite Key

**Functional Dependencies**:

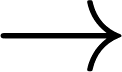
1. mall\_name, name [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) revenue, locationInMall
2. mall\_name, locationInMall [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) name

The relation is in 3NF.

**Relation 17**

**Restaurant** (name, cuisine, restaurantChain\_name, mall\_name)

**Keys**: (mall\_name, name) Composite Key

**FDs**: mall\_name, name [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) cuisine, restaurantChain\_name

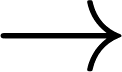
The relation is in BCNF.

**Relation 18**

**Malls** (name, revenue, location, mallChain\_name)

**Keys**: name

**Primary Key**: name

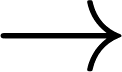
**FDs**: name [](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) mallChain\_name, revenue, location

The relation is in BCNF.

**Relation 19**

**Visit Record** (dateTime, amountSpent, mall\_name, user\_phoneNumber, shop\_name)

**Keys**: (dateTime, mall\_name, user\_phoneNumber, shop\_name) Composite key

**FDs**: dateTime, mall\_name, shop\_name, user\_phoneNumber[](https://www.codecogs.com/eqnedit.php?latex=%5Crightarrow#0) amount spent

The relation is in BCNF.

**APPENDIX C: INDIVIDUAL CONTRIBUTION FORM**

| **Full Name** | **Individual Contribution to Lab 3 Submission** | **Percentage of Contribution** | **Signature** |
| --- | --- | --- | --- |
| Gauthaman Ramya Varshini | Contributed to the initial deciding of the FDs and helped decompose the relations. | 16.67% |  |
| Pearlina Tan Qinlin | Contributed to the discussion of deciding the FDs, and normal forms as well as enhancing the ER diagram | 16.67% |  |
| Chin Ao-Wen |  | 16.67% |  |
| Tan Jie Ning, Jolynn | Contributed to the initial planning of the draft and actively provided input and suggestions to enhance the database schema | 16.67% |  |
| Sum Yuan Sen | Contributed to enhancing of ER Diagram and discussion of FDs | 16.67% |  |
| Vilan Chan | Contributed to discussion of FDs and enhancing database schema | 16.67% |  |

**APPENDIX D: USE OF AI TOOL(S) IN LAB WORK**

Each team member should indicate either A or B:

A. I affirm that my contribution(s) to the lab work is my own, produced without help from any AI tool(s).

B. I affirm that my contribution(s) to the lab work has been produced with the use of AI tool(s).

| Team member (full name) | Signature | Date | A or B |
| --- | --- | --- | --- |
| Gauthaman Ramya Varshini |  | 3/3/24 | A |
| Pearlina Tan Qinlin |  | 3/3/24 | A |
| Chin Ao-Wen |  | 3/3/24 | A |
| Tan Jie Ning, Jolynn |  | 3/3/24 | A |
| Sum Yuan Sen |  | 3/3/24 | A |
| Vilan Chan |  | 3/3/24 | A |

By signing this form, you declare that the above affirmation made is true and that you have read and understood NTU’s policy on the use of AI tools.

If any team member answered B, the team member(s) must indicate and replicate the table below for every instance AI tool(s) is used:

| Name of AI tool | < For example, ChatGPT > |
| --- | --- |
| Input prompt | < Insert the question that you asked ChatGPT > |
| Date generated |  |
| Output generated | < Insert the response verbatim from ChatGPT > |
| Output screenshots |  |
| Impact on submission | < Briefly explain which part of your submitted work was ChatGPT’s  response applied > |