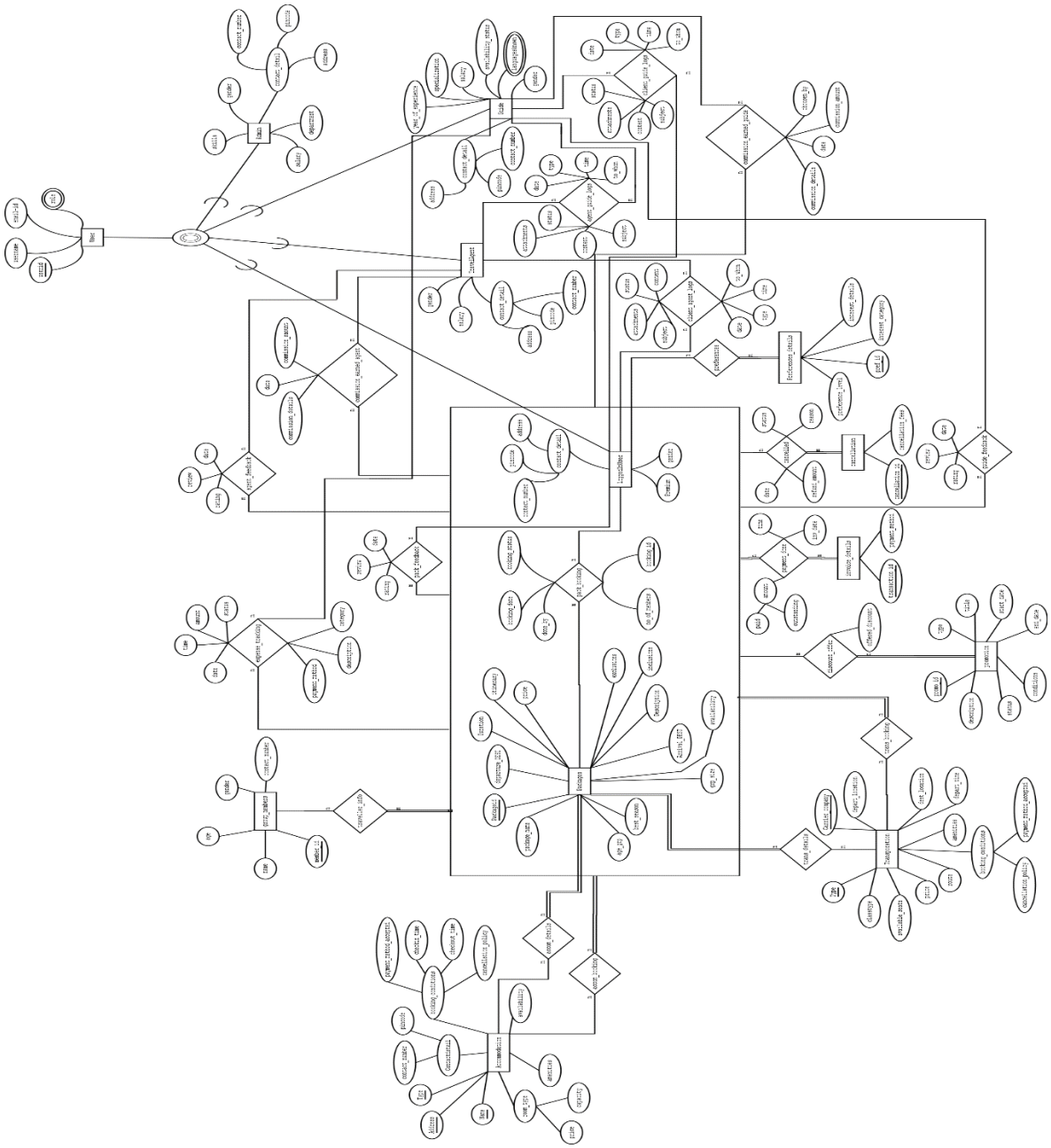
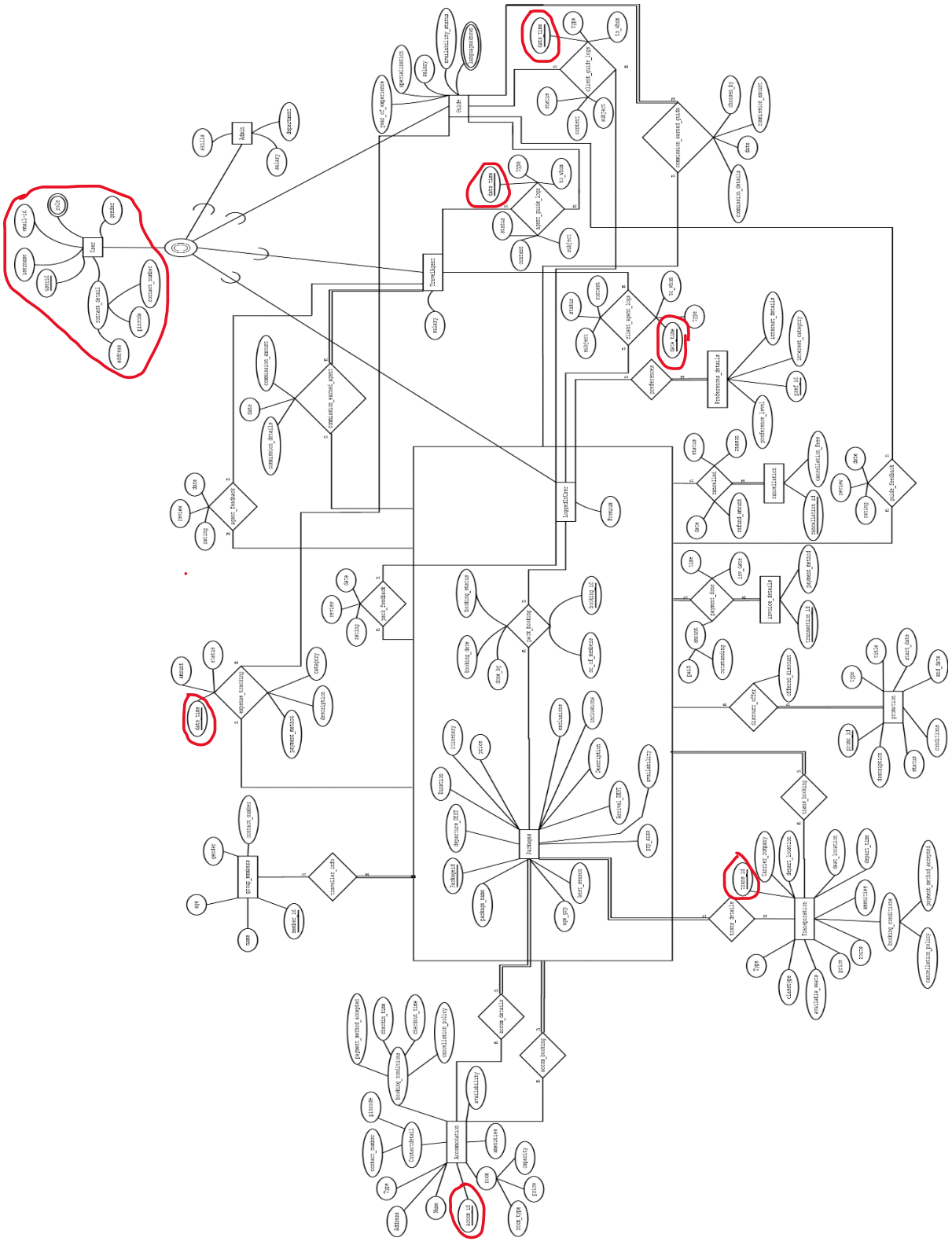
ERD to Relational mapping:

Here, in this file, we are attaching old ERD as well as modified ERD as we have made some changes in the ERD like we have added common attributes of subclass to the superclass (i.e., contact_number, pincode, address, gender), we have also added primary keys in Transportation (trans_id) and Accommodation (accom_id). We also have included date&time in primary key in expense tracking and communication logs. After adding date&time to the key, all the properties of a primary key are satisfied, earlier it was not. And then we converted the modified ERD to the **Relational Schema**.

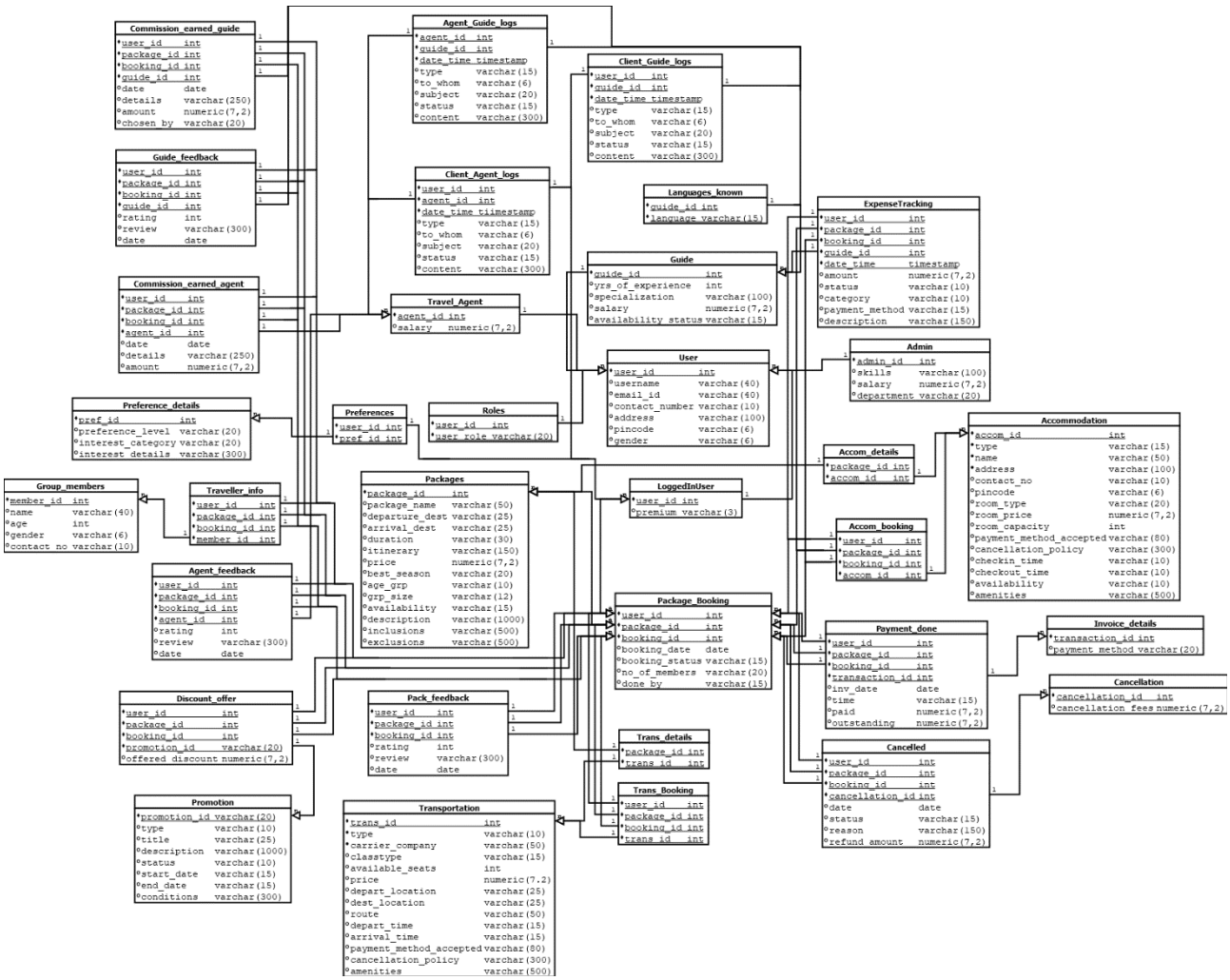
- **Old ERD:**



- **Modified ERD:**



- **Relational Schema according to Modified ERD:**



Normalization Proofs:

A relation R is in BCNF if for every FD **A→B** that holds on relation R, A is its super-key.

Projected FD SET:

FDs of Relation User:

user_id → user_name
user_id → email_id
user_id → contact_number
user_id → pincode
user_id → address
user_id → gender

As closure of {user_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation LoggedInUser:

user_id → user_name
user_id → email_id
user_id → contact_number
user_id → pincode
user_id → address
user_id → gender
user_id → premium

As closure of {user_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Travel Agent:

agent_id → user_name
agent_id → email_id
agent_id → contact_number
agent_id → pincode
agent_id → address
agent_id → gender
agent_id → salary

As closure of {agent_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Guide:

guide_id → user_name
guide_id → email_id
guide_id → contact_number
guide_id → pincode
guide_id → address
guide_id → gender
guide_id → salary
guide_id → yrs_of_experience
guide_id → specialization
guide_id → availability_status

As closure of {guide_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Admin:

admin_id → user_name
admin_id → email_id

admin_id → contact_number
admin_id → pincode
admin_id → address
admin_id → gender
admin_id → salary
admin_id → skills
admin_id → department

As closure of {admin_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Packages:
package_id → package_name
package_id → departure_dest
package_id → arrival_dest
package_id → duration
package_id → itinerary
package_id → price
package_id → best_season
package_id → age_group
package_id → grp_size
package_id → availability
package_id → description
package_id → inclusions
package_id → exclusions

As closure of {package_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Package_booking:
(user_id, package_id, booking_id) → booking_date
(user_id, package_id, booking_id) → booking_status
(user_id, package_id, booking_id) → no_of_members
(user_id, package_id, booking_id) → done_by

As closure of {user_id, package_id, booking_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Accommodation:
accom_id → type_
accom_id → name_
accom_id → address_
accom_id → contact_number
accom_id → pincode
accom_id → room_type

accom_id → room_price
accom_id → room_capacity
accom_id → payment_method_accepted
accom_id → cancellation_policy
accom_id → checkin_time
accom_id → checkout_time
accom_id → availability_
accom_id → amenities

As closure of {accom_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Transportation:
trans_id → type_
trans_id → carrier_company
trans_id → classtype
trans_id → available_seats
trans_id → price
trans_id → depart_location
trans_id → dest_location
trans_id → route_
trans_id → depart_time
trans_id → arrival_time
trans_id → payment_method_accepted
trans_id → cancellation_policy
trans_id → amenities

As closure of {trans_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Expense_tracking:
(user_id, package_id, booking_id, guide_id, date_time) → amount
(user_id, package_id, booking_id, guide_id, date_time) → status
(user_id, package_id, booking_id, guide_id, date_time) → category
(user_id, package_id, booking_id, guide_id, date_time) → payment_method
(user_id, package_id, booking_id, guide_id, date_time) → description_

As closure of {user_id, package_id, booking_id, guide_id, date_time } determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Group members:
member_id → name_
member_id → age
member_id → gender
member_id → contact_number

As closure of {member_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Invoice_details:
transaction_id → payment_method
As closure of {transaction_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Payment_done:
(user_id, package_id, booking_id, transaction_id) → inv_date
(user_id, package_id, booking_id, transaction_id) → time_
(user_id, package_id, booking_id, transaction_id) → paid
(user_id, package_id, booking_id, transaction_id) → outstanding

As closure of {user_id, package_id, booking_id, transaction_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Cancellation:
cancellation_id → cancellation_fees

As closure of {cancellation_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Cancelled:
(user_id, package_id, booking_id, cancellation_id) → date_
(user_id, package_id, booking_id, cancellation_id) → status_
(user_id, package_id, booking_id, cancellation_id) → reason
(user_id, package_id, booking_id, cancellation_id) → refund_amount

As closure of {user_id, package_id, booking_id, cancellation_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Pack_feedback:
(user_id, package_id, booking_id) → rating
(user_id, package_id, booking_id) → review
(user_id, package_id, booking_id) → date_

As closure of {user_id, package_id, booking_id } determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Agent_feedback:
(user_id, package_id, booking_id, agent_id) → rating
(user_id, package_id, booking_id, agent_id) → review
(user_id, package_id, booking_id, agent_id) → date_

As closure of {user_id, package_id, booking_id, agent_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Guide_feedback:
(user_id, package_id, booking_id, guide_id) → rating
(user_id, package_id, booking_id, guide_id) → review
(user_id, package_id, booking_id, guide_id) → date_

As closure of {user_id, package_id, booking_id, guide_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Commission_earned_agent:
(user_id, package_id, booking_id, agent_id) → date_
(user_id, package_id, booking_id, agent_id) → details
(user_id, package_id, booking_id, agent_id) → amount

As closure of {user_id, package_id, booking_id, agent_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Commission_earned_guide:
(user_id, package_id, booking_id, guide_id) → date_
(user_id, package_id, booking_id, guide_id) → details
(user_id, package_id, booking_id, guide_id) → amount
(user_id, package_id, booking_id, guide_id) → chosen_by

As closure of {user_id, package_id, booking_id, guide_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Preference_details:
pref_id → preference_level
pref_id → interest_category
pref_id → interest_details

As closure of {pref_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Promotion:
promotion_id → type_
promotion_id → title
promotion_id → description_
promotion_id → status_
promotion_id → startdate
promotion_id → enddate
promotion_id → conditions

As closure of {promotion_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Discount_offer:
(user_id, package_id, booking_id, promotion_id) → offered_discount

As closure of {user_id, package_id, booking_id, promotion_id} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Client_agent_logs:
(user_id, agent_id, date_time) → type_
(user_id, agent_id, date_time) → to_whom
(user_id, agent_id, date_time) → subject_
(user_id, agent_id, date_time) → status_
(user_id, agent_id, date_time) → content

As closure of {user_id, agent_id, date_time} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Client_guide_logs:
(user_id, guide_id, date_time) → type_
(user_id, guide_id, date_time) → to_whom
(user_id, guide_id, date_time) → subject_
(user_id, guide_id, date_time) → status_
(user_id, guide_id, date_time) → content

As closure of {user_id, guide_id, date_time} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

FDs of Relation Agent_guide_logs:
(agent_id, guide_id, date_time) → type_
(agent_id, guide_id, date_time) → to_whom
(agent_id, guide_id, date_time) → subject_
(agent_id, guide_id, date_time) → status_
(agent_id, guide_id, date_time) → content

As closure of {agent_id, guide_id, date_time} determines all the attributes of this relation so it is a super-key. Hence, this relation is in BCNF.

Hence, we have proved that all the tables are in BCNF and so our Relational Schema is Good having no redundancies in it.

Minimal FD set:

user_id → user_name
user_id → email_id
user_id → contact_number
user_id → pincode
user_id → address
user_id → gender
user_id (LoggedINUser) → user_name
user_id (LoggedINUser) → email_id
user_id (LoggedINUser) → contact_number
user_id (LoggedINUser) → pincode
user_id (LoggedINUser) → address
user_id (LoggedINUser) → gender
user_id (LoggedINUser) → premium
agent_id → user_name
agent_id → email_id
agent_id → contact_number
agent_id → pincode
agent_id → address
agent_id → gender
agent_id → salary
guide_id → user_name
guide_id → email_id
guide_id → contact_number
guide_id → pincode
guide_id → address
guide_id → gender
guide_id → salary
guide_id → yrs_of_experience
guide_id → specialization
guide_id → availability_status
admin_id → user_name
admin_id → email_id
admin_id → contact_number
admin_id → pincode
admin_id → address
admin_id → gender
admin_id → salary
admin_id → skills
admin_id → department
package_id → package_name
package_id → departure_dest
package_id → arrival_dest
package_id → duration
package_id → itinerary
package_id → price

package_id → best_season
package_id → age_group
package_id → grp_size
package_id → availability
package_id → description
package_id → inclusions
package_id → exclusions
(user_id, package_id, booking_id) → booking_date
(user_id, package_id, booking_id) → booking_status
(user_id, package_id, booking_id) → no_of_members
(user_id, package_id, booking_id) → done_by
accom_id → type_
accom_id → name_
accom_id → address_
accom_id → contact_number
accom_id → pincode
accom_id → room_type
accom_id → room_price
accom_id → room_capacity
accom_id → payment_method_accepted
accom_id → cancellation_policy
accom_id → checkin_time
accom_id → checkout_time
accom_id → availability_
accom_id → amenities
trans_id → type_
trans_id → carrier_company
trans_id → classtype
trans_id → available_seats
trans_id → price
trans_id → depart_location
trans_id → dest_location
trans_id → route_
trans_id → depart_time
trans_id → arrival_time
trans_id → payment_method_accepted
trans_id → cancellation_policy
trans_id → amenities
(user_id, package_id, booking_id, guide_id, date_time) → amount
(user_id, package_id, booking_id, guide_id, date_time) → status
(user_id, package_id, booking_id, guide_id, date_time) → category
(user_id, package_id, booking_id, guide_id, date_time) → payment_method
(user_id, package_id, booking_id, guide_id, date_time) → description_
member_id → name_
member_id → age

member_id → gender
member_id → contact_number
transaction_id → payment_method
(user_id, package_id, booking_id, transaction_id) → inv_date
(user_id, package_id, booking_id, transaction_id) → time_
(user_id, package_id, booking_id, transaction_id) → paid
(user_id, package_id, booking_id, transaction_id) → outstanding
cancellation_id → cancellation_fees
(user_id, package_id, booking_id, cancellation_id) → date_
(user_id, package_id, booking_id, cancellation_id) → status_
(user_id, package_id, booking_id, cancellation_id) → reason
(user_id, package_id, booking_id, cancellation_id) → refund_amount
(user_id, package_id, booking_id) → rating
(user_id, package_id, booking_id) → review
(user_id, package_id, booking_id) → date_
(user_id, package_id, booking_id, agent_id) → rating
(user_id, package_id, booking_id, agent_id) → review
(user_id, package_id, booking_id, agent_id) → date_
(user_id, package_id, booking_id, guide_id) → rating
(user_id, package_id, booking_id, guide_id) → review
(user_id, package_id, booking_id, guide_id) → date_
(user_id, package_id, booking_id, agent_id) → date_
(user_id, package_id, booking_id, agent_id) → details
(user_id, package_id, booking_id, agent_id) → amount
(user_id, package_id, booking_id, guide_id) → date_
(user_id, package_id, booking_id, guide_id) → details
(user_id, package_id, booking_id, guide_id) → amount
(user_id, package_id, booking_id, guide_id) → chosen_by
pref_id → preference_level
pref_id → interest_category
pref_id → interest_details
promotion_id → type_
promotion_id → title
promotion_id → description_
promotion_id → status_
promotion_id → startdate
promotion_id → enddate
promotion_id → conditions
(user_id, package_id, booking_id, promotion_id) → offered_discount
(user_id, agent_id, date_time) → type_
(user_id, agent_id, date_time) → to_whom
(user_id, agent_id, date_time) → subject_
(user_id, agent_id, date_time) → status_
(user_id, agent_id, date_time) → content
(user_id, guide_id, date_time) → type_

(user_id, guide_id, date_time) → to_whom
(user_id, guide_id, date_time) → subject_
(user_id, guide_id, date_time) → status_
(user_id, guide_id, date_time) → content
(agent_id, guide_id, date_time) → type_
(agent_id, guide_id, date_time) → to_whom
(agent_id, guide_id, date_time) → subject_
(agent_id, guide_id, date_time) → status_
(agent_id, guide_id, date_time) → content