

Airbnb System Normalization

We will list all of the tables in our database system and discuss whether or not they are in 2NF and 3NF. If they are not in 3NF, we will normalize them into 3NF.

- User(AccountID, FirstName, LastName, Day, Month, Year, PersonalEmail, WorkEmail, PhoneNumber, ProfilePhotoLink, Description, Number, Street, City, State, Zip)
 - Every non-prime attribute is fully dependent on the key (AccountID), so this table is in at least 2NF
 - Assuming that each account has a unique PersonalEmail, WorkEmail, PhoneNumber, and ProfilePhotoLink, they are candidate keys, so it does not matter that other attributes are functionally dependent on them.
 - Assume that multiple accounts can have the same address (e.g. family members, roommates), so no attributes are functionally dependent on address
 - One zip code can be in multiple states, so State is not functionally dependent on Zip
 - No non-prime attribute is transitively dependent on the primary key, so this table is in 3NF
- Languages_Spoken(AccountID (FK), Language)
 - There are no non-prime attributes, so the table is in 3NF
- Host(AccountID (FK), isSuperhost, ReviewsAbout, ReviewsWritten, CancellationRate, ResponseRate)
 - Every non-prime attribute is fully dependent on the key (AccountID), so this table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so this table is in 3NF
- Guest(AccountID (FK), ReviewsAbout, ReviewsWritten)
 - Each non-prime attribute is fully dependent on the key (AccountID), so this table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so this table is in 3NF
- Payout_Method(PayoutMID, AccountID (FK), PayoutDetails)

- PayoutDetails is fully dependent on the key (PayoutMID, AccountID), so this table is in at least 2NF
- Since there is only one non-prime attribute, this table is in 3NF
- Payment_Method(PaymentMID, AccountID (FK), PaymentDetails)
 - PaymentDetails is fully dependent on the key (PaymentMID, AccountID), so this table is in at least 2NF
 - Since there is only one non-prime attribute, this table is in 3NF
- Booking(BookingID, PaymentMID (FK), PayoutMID (FK), AccountID (FK), ListingID (FK), StartDate, EndDate, DateOfBooking, Discounts, ServiceFee, ListPrice, CleaningFees)
 - BookingID -> (StartDate, EndDate, DateOfBooking, Discounts)
 - ListingID -> (ServiceFee, ListPrice, CleaningFees)
 - Since we have non-prime attributes which are not fully dependent on the key (BookingID, PaymentMID, PayoutMID, AccountID, ListingID), this table is not in 2NF
 - We decompose into the following three tables:
 - BookingA(BookingID, StartDate, EndDate, DateOfBooking, Discounts)
 - Each non-prime attribute is fully dependent on the key (BookingID), so this table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so this table is in 3NF
 - BookingB(ListingID (FK), ServiceFee, ListPrice, CleaningFees)
 - Each non-prime attribute is fully dependent on the key (ListingID), so this table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so this table is in 3NF
 - BookingC(BookingID (FK), PaymentMID (FK), PayoutMID (FK), AccountID (FK), ListingID (FK))
 - There are no non-prime attributes, so the table is in 3NF
- Guest_Review(BookingID (FK), Rating, Comment)
 - Each non-prime attribute is fully dependent on the key (BookingID), so this table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so this table is in 3NF
- Host_Review(BookingID (FK), Rating, Comment)
 - Each non-prime attribute is fully dependent on the key (BookingID), so this table is in at least 2NF

- No non-prime attribute is transitively dependent on the primary key, so this table is in 3NF
- Listing(ListingID, AccountID (FK), Number, Street, City, State, Zip, AverageRating, NumGuests, Description, BookingType, CancellationPolicy, LocationDescription)
 - ListingID -> (Number, Street, City, State, Zip, AverageRating, NumGuests, Description, BookingType, CancellationPolicy, LocationDescription)
 - Since we have non-prime attributes which are not fully dependent on the key (ListingID, AccountID), this table is not in 2NF
 - We decompose into the following two tables:
 - ListingA(ListingID, Number, Street, City, State, Zip, AverageRating, NumGuests, Description, BookingType, CancellationPolicy, LocationDescription)
 - Each non-prime attribute is fully dependent on the key (ListingID), so this table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so this table is in 3NF
 - ListingB(ListingID (FK), AccountID (FK))
 - There are no non-prime attributes, so the table is in 3NF
- Accessibility(ListingID (FK), AccessibilityFeature)
 - There are no non-prime attributes, so the table is in 3NF
- Picture_Link(ListingID (FK), PictureLink)
 - There are no non-prime attributes, so the table is in 3NF
- Health_Safety(ListingID (FK), HealthSafetyFeature)
 - There are no non-prime attributes, so the table is in 3NF
- Rental_Listing(ListingID (FK), NumBedrooms, NumBathrooms, NumBeds, PricePerNight, HouseRules, HouseManual, CheckInInstructions, CleaningFee, ServiceFee, MinLengthOfStay, MaxLengthOfStay, PrepTimeRequired)
 - Each non-prime attribute is fully dependent on the key (ListingID), so the table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so the table is in 3NF
- Rental_Amenity(AmenityName, Category)
 - Category is fully dependent on the key (AmenityName) so the table is in at least 2NF
 - Since there is only one non-prime attribute, the table is in 3NF
- Has_Amenity(ListingID (FK), AmenityName (FK))
 - There are no non-prime attributes, so the table is in 3NF

- Experience_Listing(ListingID (FK), Modality, LengthOfTime, Price, GuestRequirements)
 - Each non-prime attribute is fully dependent on the key (ListingID), so the table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so the table is in 3NF
- What_To_Bring(ListingID (FK), ItemToBring)
 - There are no non-prime attributes, so the table is in 3NF
- Whats_Included(ListingID (FK), ItemIncluded)
 - There are no non-prime attributes, so the table is in 3NF
- Qualities(ListingID (FK), Quality)
 - There are no non-prime attributes, so the table is in 3NF
- Themes(ListingID (FK), Theme)
 - There are no non-prime attributes, so the table is in 3NF
- Languages_Offered(ListingID (FK), Language)
 - There are no non-prime attributes, so the table is in 3NF
- Wishlist(AccountID (FK))
 - There are no non-prime attributes, so the table is in 3NF
- Wishlist_Listing(AccountID (FK), ListingID (FK))
 - There are no non-prime attributes, so the table is in 3NF
- Guidebook(AccountID (FK), GuidebookID)
 - There are no non-prime attributes, so the table is in 3NF
- Guidebook_Entry((AccountID, GuidebookID) (FK), EntryName, EntryType, Description, Category)
 - Each non-prime attribute is fully dependent on the key ((AccountID, GuidebookID), EntryName), so the table is in at least 2NF
 - No non-prime attribute is transitively dependent on the primary key, so the table is in 3NF
- Guidebook_For_Listing((AccountID, GuidebookID) (FK), ListingID (FK))
 - There are no non-prime attributes, so the table is in 3NF

Now that we have normalized all of the tables in our database system to 3NF, we will show the final relational schema after normalization.

- User(AccountID, FirstName, LastName, Day, Month, Year, PersonalEmail, WorkEmail, PhoneNumber, ProfilePhotoLink, Description, Number, Street, City, State, Zip)
- Languages_Spoken(AccountID (FK), Language)
- Host(AccountID (FK), isSuperhost, ReviewsAbout, ReviewsWritten, CancellationRate, ResponseRate)
- Guest(AccountID (FK), ReviewsAbout, ReviewsWritten)
- Payout_Method(PayoutMID, AccountID (FK), PayoutDetails)
- Payment_Method(PaymentMID, AccountID (FK), PaymentDetails)
- BookingA(BookingID, StartDate, EndDate, DateOfBooking, Discounts)
- BookingB(ListingID (FK), ServiceFee, ListPrice, CleaningFees)
- BookingC(BookingID (FK), PaymentMID (FK), PayoutMID (FK), AccountID (FK), ListingID (FK))
- Guest_Review(BookingID (FK), Rating, Comment)
- Host_Review(BookingID (FK), Rating, Comment)
- ListingA(ListingID, Number, Street, City, State, Zip, AverageRating, NumGuests, Description, BookingType, CancellationPolicy, LocationDescription)
- ListingB(ListingID (FK), AccountID (FK))
- Accessibility(ListingID (FK), AccessibilityFeature)
- Picture_Link(ListingID (FK), PictureLink)
- Health_Safety(ListingID (FK), HealthSafetyFeature)
- Rental_Listing(ListingID (FK), NumBedrooms, NumBathrooms, NumBeds, PricePerNight, HouseRules, HouseManual, CheckInInstructions, CleaningFee, ServiceFee, MinLengthOfStay, MaxLengthOfStay, PrepTimeRequired)
- Rental_Amenity(AmenityName, Category)
- Has_Amenity(ListingID (FK), AmenityName (FK))
- Experience_Listing(ListingID (FK), Modality, LengthOfTime, Price, GuestRequirements)
- What_To_Bring(ListingID (FK), ItemToBring)
- Whats_Included(ListingID (FK), ItemIncluded)
- Qualities(ListingID (FK), Quality)
- Themes(ListingID (FK), Theme)
- Languages_Offered(ListingID (FK), Language)
- Wishlist(AccountID (FK))
- Wishlist_Listing(AccountID (FK), ListingID (FK))

- Guidebook(AccountID (FK), GuidebookID)
- Guidebook_Entry((AccountID, GuidebookID) (FK), EntryName, EntryType, Description, Category)
- Guidebook_For_Listing((AccountID, GuidebookID) (FK), ListingID (FK))

Foreign Keys:

- Language_Spoken.AccountID references User.AccountID
- Host.AccountID references User.AccountID
- Guest.AccountID references User.AccountID
- Payout_Method.AccountID references Host.AccountID
- Payment_Method.AccountID references Guest.AccountID
- BookingB.ListingID references ListingA.ListingID
- BookingC.BookingID references BookingA.BookingID
- BookingC.PaymentMID references Payment_Method.PaymentMID
- BookingC.PayoutMID references Payout_Method.PayoutMID
- BookingC.AccountID references Guest.AccountID
- BookingC.ListingID references ListingA.ListingID
- Guest_Review.BookingID references BookingA.BookingID
- Host_Review.BookingID references BookingA.BookingID
- ListingB.ListingID references ListingA.ListingID
- ListingB.AccountID references Host.AccountID
- Accessibility.ListingID references ListingA.ListingID
- Picture_Link.ListingID references ListingA.ListingID
- Health_Safety.ListingID references ListingA.ListingID
- Rental_Listing.ListingID references ListingA.ListingID
- Has_Amenity.ListingID references ListingA.ListingID
- Has_Amenity.AmenityName references Amenity.AmenityName
- Experience_Listing.ListingID references ListingA.ListingID
- What_To_Bring.ListingID references Experience_Listing.ListingID
- Whats_Included.ListingID references Experience_Listing.ListingID
- Qualities.ListingID references Experience_Listing.ListingID
- Themes.ListingID references Experience_Listing.ListingID
- Languages_Offered.ListingID references Experience_Listing.ListingID
- Wishlist.AccountID references Guest.AccountID
- Wishlist_Listing.AccountID references Wishlist.AccountID
- Wishlist_Listing.ListingID references ListingA.ListingID

Assignment-3

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- Guidebook.AccountID references Host.AccountID
- Guidebook_Entry.(AccountID, GuidebookID) references Guidebook.(AccountID, GuidebookID)
- Guidebook_For_Listing.(AccountID, GuidebookID) references Guidebook.(AccountID, GuidebookID)
- Guidebook_For_Listing.ListingID references ListingA.ListingID