2. Relational Algebra

> ⑦ Question
>
> For queries Q1 - Q6, give the corresponding relational algebra expression

Q1

$$R_1 = \text{Person} \bowtie_{\text{Person.PersonID}=\text{Passenger.PersonID}} \text{Passenger}$$

$$R_2 = \sigma_{\substack{\text{Age}\geq 20 \\ \wedge\ \text{Age}\leq 30 \\ \wedge\ (\text{DietaryPref}=\text{'Vegan'} \\ \vee\ \text{DietaryPref}=\text{'Vegetarian'})}}(R_1)$$

$$\text{Result} = \pi_{\text{PersonID, Name, Age}}(R_2)$$

Q2

a.

$$\gamma_{\text{Model},\text{count}(*)\rightarrow\text{NumAirplanes}}(\text{Airplane})$$

b.

$$R_1 = \text{Airplane} \bowtie_{\text{AirlineAlias} = \text{Alias}} \text{Airline}$$

$$R_2 = \sigma_{\substack{\text{Name}=\text{'Air Canada'} \\ \vee\ \text{Name}=\text{'Etihad Airways'} \\ \vee\ \text{Name}=\text{'United Airlines'}}}(R_1)$$

$$\text{Result} = \gamma_{\substack{\text{Name,Model,} \\ \text{count}(*)\rightarrow\text{NumAirplanes}}}(R_2)$$

Q3

a.

$$R_1 = \text{Ticket} \bowtie_{\substack{\text{FlightNo} = \text{FlightNo} \\ \wedge\ \text{FlightDepDate} = \text{DepDate}}} \text{ScheduledFlight}$$

$$R_2 = R_1 \bowtie_{\text{AirlineAlias} = \text{Alias}} \text{Airline}$$

$$R_3 = R_2 \bowtie_{\text{Ticket.TicketNo} = \text{Baggage.TicketNo}} \text{Baggage}$$

$$R_4 = \sigma_{\text{Name='Air Canada'}}(R_3)$$

$$R_5 = \pi_{\text{TicketNo,TotalWeight}}(R_4)$$

$$\text{Result} = \gamma_{\text{TicketNo, avg(TotalWeight)} \to \text{AverageBaggageWeight}}(R_5)$$

b.

$$R_1 = \text{Ticket} \bowtie_{\substack{\text{FlightNo} = \text{FlightNo} \\ \wedge\ \text{FlightDepDate} = \text{DepDate}}} \text{ScheduledFlight}$$

$$R_2 = \text{Baggage} \bowtie_{\text{TicketNo} = \text{TicketNo}} R_1$$

$$R_3 = \sigma_{\substack{\text{BagType='Oversized'} \\ \wedge\ \text{Fragile=False} \\ \wedge\ \text{TotalWeight}>90 \\ \wedge\ \text{DepDate}\geq\text{'2023-12-10'} \\ \wedge\ \text{DepDate}\leq\text{'2024-01-03'}}}(R_2)$$

$$\text{Result} = \pi_{\text{TicketNo, TotalWeight}}(R_3)$$

Q4

$$R_1 = \sigma_{\substack{\text{srcAirport='YYZ'} \\ \wedge\ \text{dstAirport='MCO'}}}(\text{Route})$$

$$R_2 = R_1 \bowtie_{\text{Route.RouteID=ScheduledFlight.RouteID}} \text{ScheduledFlight}$$

$$R_3 = R_2 \bowtie_{\substack{\text{ScheduledFlight.FlightNo=Ticket.FlightNo} \\ \wedge\ \text{ScheduledFlight.DepDate=Ticket.FlightDepDate}}} \text{Ticket}$$

$$R_4 = R_3 \bowtie_{\text{Ticket.TicketNo=Book.TicketNo}} \text{Book}$$

$$\text{MinPrice} = \mathcal{G}_{\emptyset,\ \text{min\_price} \leftarrow \text{MIN(Price)}}\left(\Pi_{\text{Price}}(R_4)\right)$$

$$\text{Result} = \Pi_{\substack{\text{TicketNo, DepDate} \rightarrow \text{DepartureDate,} \\ \text{Price} \rightarrow \text{minPrice, Website}}}\left(\sigma_{\text{Price=min\_price}}(R_4 \times \text{MinPrice})\right)$$

Q5

a.

$$R_1 = \Pi_{\text{RouteID,AirlineAlias}}(\text{Use})$$

$$R_2 = \mathcal{G}_{\text{RouteID,NumAirlines} \leftarrow \text{COUNT(AirlineAlias)}}(R_1)$$

$$\text{Result} = \Pi_{\text{RouteID}}(\sigma_{\text{NumAirlines} \geq 3}(R_2))$$

b.

$$R_1 = \text{Route} \bowtie_{\text{Route.RouteID = Use.RouteID}} \text{Use}$$

$$R_2 = \sigma_{\text{AirlineAlias IS NULL}}(R_1)$$

$$\text{Result} = \Pi_{\text{RouteID,}\ \substack{\text{srcAirport} \rightarrow \text{SourceAirport,} \\ \text{dstAirport} \rightarrow \text{DestinationAirport}}}(R_2)$$

Q6

a.

$$
\begin{aligned}
&\text{Staff} = \\
&\quad \Pi_{\text{PersonID}}(\text{Pilot}) \cup \\
&\quad \Pi_{\text{PersonID}}(\text{CabinCrew}) \cup \\
&\quad \Pi_{\text{PersonID}}(\text{GroundStaff}) \\
&\text{StaffPassengers} = \\
&\quad \Pi_{\text{PersonID}}(\text{Passenger}) \cap \text{Staff} \\
&\text{Result} = \\
&\quad \mathcal{G}_{\emptyset,\ \text{NumStaffPassengers} \leftarrow \text{COUNT}(\text{PersonID})}(\text{StaffPassengers})
\end{aligned}
$$

b.

$$
\begin{aligned}
&\text{CabinCrewWithAirline} = \\
&\quad \Pi_{\text{PersonID},\ \text{AirlineAlias}}(\text{CabinCrew}) \\
&\text{PilotsWithPlanes} = \\
&\quad \Pi_{\text{PersonID},\ \text{AirlineAlias}}(\\
&\qquad \text{Pilot} \bowtie_{\text{Pilot.PersonID}=\text{Flies.PilotID}} \text{Flies} \\
&\qquad \bowtie_{\text{Flies.AirplaneSNo}=\text{Airplane.SerialNo}} \text{Airplane} \\
&\quad) \\
&\text{AllStaffWithAirline} = \\
&\quad \text{CabinCrewWithAirline} \cup \text{PilotsWithPlanes} \\
&\text{StaffPassengers} = \\
&\quad \text{AllStaffWithAirline} \bowtie_{\text{PersonID}} \Pi_{\text{PersonID}}(\text{Passenger}) \\
&\text{Result} = \\
&\quad \mathcal{G}_{\text{AirlineAlias},\ \text{StaffPassengerCount} \leftarrow \text{COUNT}(\text{PersonID})}(\text{StaffPassengers})
\end{aligned}
$$