

Relational Algebra

Query 1:

$$\delta(\pi_{ID,FirstName,LastName,Sex,DateOfBirth}(\sigma_{DateOfBirth < 2001-11-01 \wedge Occupation = \%Student\% \wedge ID = PassengerID}(\mathbf{Person} \times [\pi_{PassengerID}(\sigma_{Date = __ - 01 - 20 \wedge FlightNumber = 11}(\mathbf{Take}))])))$$

Query 2:

$$R1 := \pi_{TotalFare}(\gamma_{Sum(FlightFare) \rightarrow TotalFare}(\text{Operate} \bowtie [\gamma_{FlightNumber, Sum(Fare) \rightarrow FlightFare}(\mathbf{Class})])))$$

$$\pi_{Carrier, Name}(\sigma_{TotalFare \geq \forall TotalFare \in R1}(\mathbf{Airline} \bowtie (\gamma_{Carrier, Sum(FlightFare) \rightarrow TotalFare}(\text{Operate} \bowtie [\gamma_{FlightNumber, Sum(Fare) \rightarrow FlightFare}(\mathbf{Class})]))))$$

Query 3:

$$\tau_{NumberOfDelays}(\gamma_{Carrier, Name, Count(FlightNumber) \rightarrow NumberOfDelays}(\sigma_{SchedArrTime \neq ArrTime}(\mathbf{Airline} \bowtie \mathbf{Operate} \bowtie \mathbf{Flight})))$$

Query 4:

$$\tau_{Name}(\pi_{Name}(\sigma_{Count \geq 3} \gamma_{Name, Count(Name) \rightarrow Count}(\mathbf{AirportInCity}))))$$

Query 5.a:

$$R1 := \pi_{Count2}(\gamma_{Origin, Dest, count(*) \rightarrow Count2}(\mathbf{RouteServe}))$$
$$\delta(\pi_{Origin, Dest}(\sigma_{Count1 \leq \forall Count2 \in R1} \gamma_{Origin, Dest, Count(*) \rightarrow Count1}(\mathbf{RouteServe})))$$

Query 5.b:

$$\pi_{Carrier, Name}(\mathbf{Airline} \bowtie [\pi_{Carrier, Count}(\sigma_{Count = 1}(\gamma_{Carrier, Count(\delta(FlightNumber)) \rightarrow Count}(\text{Operate} \bowtie \mathbf{RouteServe}))))])$$

Query 5.c:

$$\mathbf{Routes} := \pi_{Carrier, Origin, Dest}(\text{Operate} \bowtie \mathbf{RouteServe})$$
$$R1 := \pi_{Carrier}(\sigma_{Origin = EWR \wedge Origin = JFK}(\mathbf{Routes}))$$
$$R2 := \pi_{Carrier}(\sigma_{Origin \neq JFK}(\pi_{Carrier, Origin, Dest}(\sigma_{Origin \neq EWR}(\mathbf{Routes}))))$$
$$\pi_{Carrier, Name}(\sigma_{\exists Carrier \in R1 \wedge \nexists Carrier \in R2}(\mathbf{Airline}))$$

Query 5.d:

$$\pi_{\text{Carrier,Name}}(\text{Airline} \bowtie [\pi_{\text{Carrier,Count}}(\sigma_{\text{Count} \leq 2}(\gamma_{\text{Carrier,Count}}(\delta(\text{FlightNumber})) \rightarrow \text{Count}(\text{Operate} \bowtie \text{RouteServe}))))]$$

Query 6.a:

$$\gamma_{\text{Carrier,Name,Count(PassengerID)} \rightarrow \text{NumberOfPassengers}}(\sigma_{\text{"2013-01-01"} \leq \text{Date} \leq \text{"2013-01-03"}}(\text{Take} \bowtie \text{Operate} \bowtie \text{Airline}))$$

Query 6.b:

$$\begin{aligned} \text{GreaterThan500}_1 &:= \pi_{\text{Origin, Dest}}(\sigma_{\text{Count} > 500}(\gamma_{\text{Origin, Dest, Count(PassengerID)} \rightarrow \text{Count}}(\text{Take} \bowtie \text{RouteServe}))) \\ \rho(\text{Origin1, Dest1}) &:= \text{GreaterThan500}_2 \\ R_1 &:= \pi_{\text{Origin, Dest}}(\sigma_{\text{Origin1=Dest} \wedge \text{Dest1=Origin}}(\text{GreaterThan500}_1 \times \text{GreaterThan500}_2)) \\ \delta(\pi_{\text{Origin, Dest}}(\sigma_{\text{Origin} < \text{Dest} \vee (\nexists \text{Origin} \in R_1 \wedge \nexists \text{Dest} \in R_1)}(\text{GreaterThan500}_1)))) \end{aligned}$$

Query 6.c:

$$\begin{aligned} R_2 &:= \pi_{\text{Count}}(\gamma_{\text{Dest, Count(Dest)} \rightarrow \text{Count}}(\text{RouteServe})) \\ R_1 &:= \pi_{\text{Dest}}(\sigma_{\text{Count} \geq \forall \text{Count} \in R_2}(\gamma_{\text{Dest, Count(Dest)} \rightarrow \text{Count}}(\text{RouteServe}))) \\ &\quad \pi_{\text{Name}}(\sigma_{\exists \text{Code} \in R_1}(\text{AirportInCity})) \end{aligned}$$

Query 7:

$$\begin{aligned} \text{Take1} &:= \pi(\text{Take}) \\ \rho(\text{Date1, FlightNumber1, SchedArrTime1, SchedDepTime1, PassengerID1, Type1, Class1}) &:= \text{Take1} \\ \text{RouteServe1} &:= \pi(\text{RouteServe}) \\ \rho(\text{Date1, FlightNumber1, SchedArrTime1, SchedDepTime1, Origin1, Dest1}) &:= \text{RouteServe1} \\ &\quad \delta(\pi_{\text{ID, FirstName, LastName}}(\sigma_{\text{"2013-01-01"} \leq \text{take.date} \leq \text{"2013-01-31"} \wedge \text{"2013-01-01"} \leq \text{take1.date} \leq \text{"2013-01-31"}}(\text{Person} \bowtie_{\text{ID=PassengerID}} [\pi_{\text{PassengerID=PassengerID1} \wedge \text{Origin} = \text{Dest1} \wedge \text{Dest} = \text{Origin1}}([\text{Take} \bowtie \text{RouteServe}] \times [\text{Take1} \bowtie \text{RouteServe1}]))])) \end{aligned}$$

Query 8:

$$\text{FlightsForPassenger} := \pi_{\text{PassengerID}, \text{Origin}}(\text{Passenger} \bowtie \text{Take} \bowtie \text{RouteServe})$$
$$R1 := \pi_{\text{Code}}(\sigma_{\text{Name}="Los Angeles"}(\text{AirportInCity}))$$
$$\pi_{\text{PassengerID}, \text{FirstName}, \text{LastName}}(\sigma_{\text{Count} \geq 3}(\gamma_{\text{PassengerID}, \text{FirstName}, \text{LastName}, \text{Count}(\text{PassengerID}) \rightarrow \text{Count}}(\sigma_{\exists \text{Origin} \in R1}(\text{Person} \bowtie \text{FlightsForPassenger}))))$$

Query 9:

$$\pi_{\text{Code}, \text{Name}}(\sigma_{\text{PassengerID} > 1000}(\gamma_{\text{Code}, \text{Name}}(\sigma_{\text{"2013-01-01"} \leq \text{Date} \leq \text{"2013-01-07"} \wedge (\text{Code} = \text{Origin} \vee \text{Code} = \text{Dest})} \text{Airport} \times [\text{RouteServe} \bowtie \text{Take}])))$$

Query 10.a:

$$\pi_{\text{Origin}, \text{Dest}}(\gamma_{\text{Origin}, \text{Dest}}(\sigma_{\text{Count}(\delta(\text{Carrier})) \geq 5} \text{RouteServe} \bowtie \text{Operate}))$$

Query 10.b:

$$\text{TRC} := \pi_{\text{PassengerID}, \text{Origin}, \text{Dest}, \text{Fare}}(\text{RouteServe} \bowtie \text{Take} \bowtie \text{Class})$$
$$R1 := \pi(\gamma_{\text{Origin}, \text{Dest}, \text{Sum}(\text{Fare}) \rightarrow \text{FareSum}}(\text{TRC}))$$
$$R2 := \pi(\gamma_{\text{Origin}, \text{Dest}}(\bowtie_{\text{sum}(\text{Fare}) \rightarrow \text{Sum}} \text{TRC}))$$
$$\pi_{\text{Origin}, \text{Dest}}(\sigma_{\text{FareSum} \geq \forall \text{Sum} \in R2}(\text{R1}))$$

Query 11:

$$\text{NewFare} := \pi_{\text{Carrier}, \text{Name}, \text{Origin}, \text{Dest}, \text{Type}, \text{Class}, \text{Fare}}(\text{Airline} \bowtie \text{Class} \bowtie \text{RouteServe} \bowtie \text{Operate})$$
$$\rho_{\text{NewFare1}}(\text{Carrier1}, \text{Name}, \text{Origin}, \text{Dest}, \text{Type}, \text{Class}, \text{Fare})(\text{NewFare})$$
$$\pi_{\text{Carrier}, \text{Name}}(\sigma_{\text{Carrier} <> \text{carrier1}} \text{NewFare} \bowtie \text{NewFare1})$$

Query 12a.:

$$R1 := \delta(\pi_{\text{PassengerID}}(\text{Take} \bowtie \text{Passenger}))$$
$$\delta(\pi_{\text{ID}, \text{FirstName}, \text{LastName}}(\sigma_{\text{ID} = \text{PassengerID} \wedge \nexists \text{PassengerID} \in R1}(\text{Person} \times \text{Passenger})))$$

Query 12a.:

TakeRoute := $\pi_{\text{PassengerID}, \text{Date}, \text{FlightNumber}, \text{SchedArrTime}, \text{SchedDepTime}, \text{Origin}, \text{Dest}}$ (Take
 \bowtie Take.FlightNumber=RouteServe.FlightNumber
 \wedge Take.SchedArrTime=RouteServe.SchedArrTime
 \wedge Take.SchedDepTime=RouteServe.SchedDepTime
 RouteServe)
Temp := $\pi_{\text{PassengerID}, \text{Name}}$ ($\sigma_{\text{Code}=\text{Dest}}$ (TakeRoute \times AirportInCity))
R1 := $\delta(\pi_{\text{ID}, \text{FirstName}, \text{LastName}}(\sigma_{\text{ID}=\text{PassengerID} \wedge \text{City} \neq \text{Name}}$ (Person \times Temp)))
R2 := $\delta(\pi_{\text{ID}, \text{FirstName}, \text{LastName}}(\sigma_{\text{ID}=\text{PassengerID} \wedge \text{City} = \text{Name}}$ (Person \times Temp)))
 R1 – R2

Query 13:

$\delta(\pi_{\text{Carrier}, \text{Tailnum}}$ (AirlineOwnAirplane \bowtie Airplane)