Q1.

TABLES:

TREATMENT (disease, medication)

PERSON (SSN, firstName, lastName, phone, email, address, city, province)

PATIENT (patientID, SSN)

DOCTOR (doctorID, SSN, dos)

TREATED (doctorID, patientID, date, procedure, diagnostic)

RELATIONS:

PATIENT can suffer from many **DISEASES**

DISEASES can have many **MEDICATIONS**

DISEASE and **DISEASE_OF_SPECIALIZATION** have the same domain

PROCEDURE can be (consultation, intervention, surgery, etc)

DIAGNOSTIC can be the **DISEASE** or intervention type.

SOLUTIONS (RELATIONAL ALGEBRA):

a) **DOCTOR** who do not suffer from any **DISEASE**

$PERSON \bowtie (\pi_{SSN}(DOCTOR) - \pi_{SSN}$

$\left(\sigma_{DOCTOR.SSN=PATIENT.SSN}\left(\pi_{SSN}(DOCTOR) \times \pi_{SSN}(PATIENT)\right)\right))$

b) **PATIENTS** with more than one **DISEASE**

$PERSON \bowtie (\pi_{SSN}(\sigma_{PATIENT.patientID=A.patientID}($
$PATIENT \times \rho_A(\pi_{patientID}($
$\sigma_{T1.patientID=T2.patientID \ AND \ T1.diagnostic \neq T2.diagnostic}($
$\rho_{T1}(TREATED) \times \rho_{T2}(TREATED)))))))$

c) **DOCTORS** suffering from a **DISEASE** in their specialization

$\pi_{firstName,lastName,phone}(PERSON \bowtie \pi_{SSN}($
$\sigma_{DOCTOR.SSN=B.SSN \ AND \ DOCTOR.dos=B.diagnostic}($
$DOCTOR \times \rho_B(\pi_{SSN,diagnostic}(\sigma_{patient.patientID=A.patientID}($
$PATIENT \times \rho_A(\pi_{patientID,diagnostic}(TREATED)))))))$

d) **DISEASES** with only one medication

$$\pi_{disease}(TREATMENT - \pi_{disease}(\sigma_{T1.disease=T2.disease \ AND \ T1.medication \neq T2.medication}($$
$$\rho_{T1}(TREAMENT) \times \rho_{T2}(TREATMENT))))$$

e) **PATIENTS** with certain **DISEASES**

$$PERSON \bowtie \pi_{SSN}(\sigma_{PATIENT.patientID=A.patientID}($$
$$PATIENT \times \rho_A(\pi_{patientID}($$

$$\sigma_{diagnosis='HIV' \ OR \ diagnosis='Heart \ Disease' \ OR \ diagnosis='Diabetic' \ OR \ diagnosis='Blood \ Pressure'}(TREATMENT)))))$$

Q2:

TABLES:

FLIGHTS (flightNumber, from, to, distance, departs, arrives, price)

AIRCRAFT (aID, aName, cruisingRange)

CERTIFIED (eID, aID, date)

EMPLOYEES (eID, SSN, firstName, lastName, salary, phone, address, city, province)

PILOTS (eID, startDate, endDate)

FLIGHT_ATTENDANTS (eID, startDate, endDate)

RELATIONS:

EMPLOYEES describes all employee types

Every **PILOT** is **CERTIFIED** for some **AIRCRAFT** and only **PILOTS** are **CERTIFIED**

endDate is set to null if the **EMPLOYEE** is still working.

SOLUTIONS (RELATIONAL ALGEBRA):

a) **AIRCRAFT** that **PILOTS** that are **CERTIFIED** earn more than 95,000$

$$\pi_{aName,crusingRange}(\sigma_{AIRCRAFT.aID=C.aID}\left(AIRCRAFT \times \right.$$

$$\rho_C\left(\pi_{aID}\left(\sigma_{CERTIFIED.eID=B.eID}\left(CERTIFIED \times \rho_B\left(\pi_{eID}\left(\sigma_{PILOTS.eID=A.eID}\left(PILOTS \times \right.\right.\right.\right.\right.\right.$$

$$\left.\left.\left.\left.\left.\left.\left.\left.\left.\rho_A\left(\pi_{eID}\left(\sigma_{salary>95000}(EMPLOYEES)\right)\right)\right)\right)\right)\right)\right)\right)\right)\right)$$

b) **PILOTS** who are **CERTIFIED** for Boeing 747 and Airbus 360 **AIRCRAFT**

$EMPLOYEE \bowtie (\pi_{eID}(\sigma_{CERTIFIED.aID=A.aID}(CERTIFIED \times \rho_A($
$\pi_{aID}(\sigma_{AIRCRAFT.aName='Boeing\ 747'\ OR\ AIRCRAFT.aName='Airbus360'}(AIRCRAFT)))))$

c) **PILOTS** currently not working **CERTIFIED** for Boeing 747 and Airbus 360 **AIRCRAFT**

$EMPLOYEE \bowtie (\pi_{eID}(\sigma_{PILOTS.endDate \neq NULL}(PILOTS \times \rho_B($
$\pi_{eID}(\sigma_{CERTIFIED.aID=A.aID}(CERTIFIED \times \rho_A(\pi_{aID}($
$\sigma_{AIRCRAFT.aName='Boeing\ 747'\ OR\ AIRCRAFT.aName='Airbus360'}(AIRCRAFT)))))))))$

d) **AIRCRAFT** that can be used on routes Montreal-Vancouver and Calgary-Saskatchewan

$\pi_{AIRCRAFT.aNAme}(\sigma_{AIRCRAFT.aID=A.flightNumber}(AIRCRAFT \times \rho_A(\pi_{flightNumber}($
$\sigma_{from='Montreal'\ AND\ from='Calgary'\ AND\ to='Vancouver'\ AND\ to='Saskatchewan'}(FLIGHTS)))))$

e) **EMPLOYEES** who are **PILOTS** and **FLIGHT_ATTENDANTS**

$EMPLOYEES \bowtie \pi_{eID}(\sigma_{E1.eID=E2.eID}(\rho_{E1}(PILOTS) \times \rho_{E2}(FLIGHTATTENDANTS)))$