Assignment 3

COMP 353 CD – Databases

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1.

a) {D,F,G,H}

b) {A,C,F,G}

2.

The decomposition is NOT lossless. After performing a chase test and this failed because we couldn't produce a row with all unsubscripted symbols, we can conclude that when we join R1, R2, and R3 back together we will get extra tuples that weren't in the original relation R, making it impossible to reconstruct the original relation.

3.

a) The only key is {E ,H}
b) Minimal basis: {AB → D, D → A, E → C, C → E, F → BG, H → CF, B → A}
c) 3NF Decomposition:
    - R1(A, B, D)
    - R3(C, E)
    - R5(B, F, G)
    - R6(C, F, H)
    - R8(E, H)

d) We lost AB → D in the decomposition, hence the BCNF decomposition is NOT dependency preserving.

4.

a)

π type, gender, locName, name (
  σ YEAR(adoptDate) = 2024 ∧ YEAR(dateAdmitted) = 2025 (
    Animals ⋈ aID = animalID Admission ⋈ locID HSO_Location ⋈ animalID Adoption ⋈ SIN Adopter
)
)

b)

$$
\begin{aligned}
&\pi\ \text{aID, type, gender, chipNo}\ (\\
&\quad \text{Animals} \bowtie \text{aID} = \text{animalID}\ (\\
&\qquad \pi\ \text{animalID}\ (\\
&\qquad\quad \sigma\ \text{A1.animalID} = \text{A2.animalID} \wedge \text{A1.animalID} = \text{A3.animalID} \wedge\\
&\qquad\quad\ \text{A1.dateAdmitted} \neq \text{A2.dateAdmitted} \wedge\\
&\qquad\quad\ \text{A1.dateAdmitted} \neq \text{A3.dateAdmitted} \wedge\\
&\qquad\quad\ \text{A2.dateAdmitted} \neq \text{A3.dateAdmitted}\ (\\
&\qquad\qquad \rho\ \text{A1}\ (\text{Admission}) \times \rho\ \text{A2}\ (\text{Admission}) \times \rho\ \text{A3}\ (\text{Admission})\\
&\qquad\quad)\\
&\qquad)\\
&\quad)\\
&)
\end{aligned}
$$

c)

$$
\begin{aligned}
&\pi\ \text{name, phone}\ (\\
&\quad \sigma\ \text{Ad.province} \neq \text{H.province}\ (\\
&\qquad \text{Adopter} \bowtie \text{SIN Adoption} \bowtie \text{animalID Admission} \bowtie \text{locID HSO\_Location}\\
&\quad)\\
&) - \pi\ \text{name, phone}\ (\\
&\quad \sigma\ \text{Ad.province} = \text{H.province}\ (\\
&\qquad \rho\ \text{Ad}\ (\text{Adopter}) \bowtie \text{SIN Adoption} \bowtie \text{animalID Admission} \bowtie \text{locID}\ \rho\ \text{H}\ (\text{HSO\_Location})\\
&\quad)\\
&)
\end{aligned}
$$

d)

$$
\begin{aligned}
&\pi\ \text{name, phone}\ (\text{Adopter} \bowtie \text{SIN Adoption}) -\\
&\pi\ \text{name, phone}\ (\\
&\quad \sigma\ \text{gender} = \text{'Female'}\ (\\
&\qquad \text{Adopter} \bowtie \text{SIN Adoption} \bowtie \text{animalID Animals}\\
&\quad)\\
&)
\end{aligned}
$$

e)

$$\text{MontrealLocs} = \pi\ \text{locID}\ (\sigma\ \text{city} = \text{'Montréal'}\ (\text{HSO\_Location}))$$

```
π name, phone (
   Adopter ⋈ SIN (
      (π SIN, locID (Adoption ⋈ animalID Admission)) ÷ MontrealLocs
   )
)

AllAdopters = π SIN, name, phone (Adopter)
MontrealLocs = π locID (σ city = 'Montréal' (HSO_Location))
AdopterLocPairs = π SIN, locID (Adoption ⋈ animalID Admission)

π name, phone (
   AllAdopters - π SIN, name, phone (
      π SIN, name, phone, locID (AllAdopters × MontrealLocs) -
      π SIN, name, phone, locID (AllAdopters ⋈ SIN AdopterLocPairs)
   )
)
```