CSC742 HW3 SOLUTION

Please note that these are reference solutions. Some problems don’t have unique solutions.

Ex. 1 (Question 9.12)

(1) SHIP (SName, Owner, Ship_Type_Type, State_Name, Port_PName)

Foreign key: Ship_Type_Type (reference to “Type” attribute in SHIP_TYPE),
State_Name (reference to “Name” attribute in STATE_COUNTRY),
Port_PName (reference to “PName” attribute in PORT)

(2) SHIP_MOVEMENT (Ship_SName, Date, Time, Longitude, Latitude)

Foreign key: Ship_SName (reference to “SName” attribute in SHIP)

(3) SHIP_TYPE (Type, Tonnage, Hull)

(4) STATE_COUNTRY (Name, Continent)

(5) SEA_OCEAN_LAKE (Name)

(6) PORT (State_Name, PName, Sea_Name)

Foreign key: State_Name (reference to “Name” attribute in STATE_COUNTRY),
Sea_Name (reference to “Name” attribute in SEA_OCEAN_LAKE)

(7) VISITS (Ship_SName, State_Name, Port_PName, StartDate, EndDate)

Foreign key: Ship_SName (reference to “SName” attribute in SHIP),
State_Name (reference to “Name” attribute in STATE_COUNTRY),
Port_PName (reference to “PName” attribute in PORT)

Ex. 2.

On the original relation R = ABCDEGH, we have:

AB⁺ = ABCDEG, AC⁺ = ABCDEG, BC⁺ = ABCDEG, B⁺ = BD, AD⁺ = ADEG, E⁺ = EG

(a.) ABC

AB⁺ = ABC, BC⁺ = ABC, CA⁺ = ABC

Minimal cover: {AB → C, AC → B, BC → A}

The strongest normal form that is not violated: BCNF

(b.) ABCD

AB⁺ = ABCD, AC⁺ = ABCD, BC⁺ = ABCD, B⁺ = BD

Minimal cover: {AB → C, AC → B, BC → A, B → D}

The strongest normal form that is not violated: 1NF

Decompose it: {A, B, C} and {B, D}

(c.) ABCEG

AB⁺ = ABCEG, AC⁺ = ABCEG, BC⁺ = ABCEG, E⁺ = EG

Minimal cover: {AB → C, AC → B, BC → A, E → G, AB → E}
The strongest normal form that is not violated: 2NF
Decompose it: \{A, B, C, E\} and \{E, G\}

(d.) DCEGH
\[ E' = EG \]
Minimal cover: \{E \rightarrow G\}
The strongest normal form that is not violated: 1NF
Decompose it: \{D, C, E, H\} and \{E, G\}

(e.) ACEH
\[ AC' = ACE \]
Minimal cover: \{AC \rightarrow E\}
The strongest normal form that is not violated: 1NF
Decompose it: \{A, C, H\} and \{A, C, E\}

Ex. 3.1
1. \[ A' = AB, BC' = BCEA, EC' = ECAB, ACD' = ABCDE, BCD' = ABCDE, ECD' = ABCDE \]
   All keys for R: \{A, C, D\}, \{B, C, D\} and \{E, C, D\}

2. R is in 3NF. Because all the attributes are prime attributes.

3. R is NOT in BCNF. Because for example, we know \( A \rightarrow B \), but A is not a superkey.

Ex. 3.2
1. ‘BC \rightarrow A’ does NOT hold over schema S. Because from the first tuple, we know when \( B=2 \) and \( C=3 \), then \( A=1 \); But from the second tuple, we know that when \( B=2 \) and \( C=3 \), then \( A=4 \). So, BC cannot functionally determine A.

2. We CANNOT identify any dependency that holds over S. Because FDs depend on relation schema and its meaning, not on tuples.