15.28

- We have:

R = {Course_no, Sec_no, Offering_dept, Credit_hours, Course_level, Instructor_ssn, Semester, Year, Days_hours, Room_no, No_of_students}

{Course_no} → {Offering_dept, Credit_hours, Course_level}

{Course_no, Sec_no, Semester, Year} → {Days_hours, Room_no, No_of_students, Instructor_ssn}

{Room_no, Days_hours, Semester, Year} → {Instructor_ssn, Course_no, Sec_no}

- We have

R = {A, B, C, D, E, F, G, H, I, J, K}

A → CDE

ABGH → IJKF

JIGH → FAB

- Closure

A+ = {C, D, E}

ABGH+ = {A, B, G, H, C, D, E, I, J, K, F}

JIGH+ = {J, I, G, H, F, A, B, C, D, E, K}

=> ABGH is the keys of R

- Normalize R = {A, B, G, H, C, D, E, I, J, K, F}

- 2NF:

R1 = {A, C, D, E}

R2 = {A, B, G, H, I, J, K, F}

15.29

ORDER (O#, Odate, Cust#, Total_amount)

ORDER_ITEM(O#, I#, Qty_ordered, Total_price, Discount%)

- Natural join: R (O#, I#, Odate, Cust#, Total_amount, Qty_ordered, Total_price, Discount%)
- Keys: O, I
- FDs:

{O} → {Odate, Cust#, Total_amount}

{O, I} → {Qty_ordered}

{I} → {Discount%, Total_price}

- R is not in 2NF. 2NF normalize:

R1(O, Odate, Cust, Total_amount)

R2(I, Discount%, Total_price)

R3(O, I, Qty_ordered)

- R is not in 3NF since R is not in 2NF. 3NF of R is the same as 2NF.

15.30

CAR_SALE(Car#, Salesperson#, Date_sold, Commission%, Discount_amt)

Date_sold □ Discount_amt

Salesperson# □ Commission%

→ R(A, B, C, D, E)

C → E

B → D

- The relation is in 1NF because all attributes have single value
- The relation is not in 2NF. 2NF normalize:

R1(B, D)

R2(A, B, C, E)

- The relation is not in 3NF. 3NF normalize:

R1(B, D)

R2_1(C, E)

R2_2(A, B, C)

15.31

BOOK (Book_title, Author_name, Book_type, List_price, Author_affil, Publisher)

Book_title → Publisher, Book_type

Book_type → List_price

Author_name → Author_affil

- We have:

R(A, B, C, D, E, F)

A → FC

C → D

B → E

- Closure:

A+ = {A, F, C, D}

B+ = {B, E}

=> AB is the key of R.

Based on AB as the key:

a, R is in 1NF form because all attributes have single atomic value, but not in 2NF because have attributes that depends on a part of key.

b, Normalize

- 2NF:

R1(A, F, C)

R2(B, E)

R3(A, B, D)

- 3NF

R1(A, F, C)

R2(B, E)

R3_1(C, D)

R3_2(A, B)

15.32

DISK_DRIVE (Serial_number, Manufacturer, Model, Batch, Capacity, Retailer)
R (A, B, C, D, E, F)

a, AB is the key of R

b, C -> B

c, D -> C

d, BC -> E

15.33

R (Doctor#, Patient#, Date, Diagnosis, Treat_code, Charge)

R(A, B, C, D, E, F)

- FDs

ABC -> DEF

EC -> F

D -> AB

=> ABC is the key

- Based on the ABC as key, R is in 2NF
- Closure

ABC+ = {D, A, B, C, E, F}

15.34

CAR_SALE (Car_id, Option_type, Option_listprice, Sale_date, Option_discountedprice)
CarID → Sale_date

Option_type → Option_listprice

CarID, Option_type → Option_discountedprice

- We have

R(A, B, C, D, E)

A → D

B → C

AB → E

- Closure

AB+ = {A, B, D, C, E}

=> AB is the key of R

- Based on the key AB, R is not in 2NF because A → D and B → C. Therefor R is not in 3NF neither. Normalize:

R1(A, D)

R2(B, C)

R3(A, B, E)